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Concrete

Devoted to the Manufacture

JUNE, 1934

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Chicago, Illinois

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PREPARE NOW FOR NEXT WINTER'S CONCRETE PAVING

DESIGNS for fall millinery have long been in the making. Clothing manufacturers have already determined what styles of men's and women's apparel will be offered to the public when cold weather comes. Toy manufacturers have developed their designs and samples for the trade of next Christmas.

¶ For the same reasons that impel this advance planning and designing and manufacturing in the cases just cited, state and county highway departments should lay plans and work out construction procedure for continuing the building of concrete road and street pavements next fall and winter.

¶ In recent issues of "Concrete"—particularly the January, April and May issues and in the current number—enough detailed information has been given on the subject to enable any highway or city engineer to develop the necessary procedure for placing concrete pavements in cold weather.

¶ Engineers who wait until October to plan winter construction are not likely to get very far. Those who have a sincere desire to aid in the stabilization of employment in concrete highway and street construction are working ***now*** on their program for next winter.

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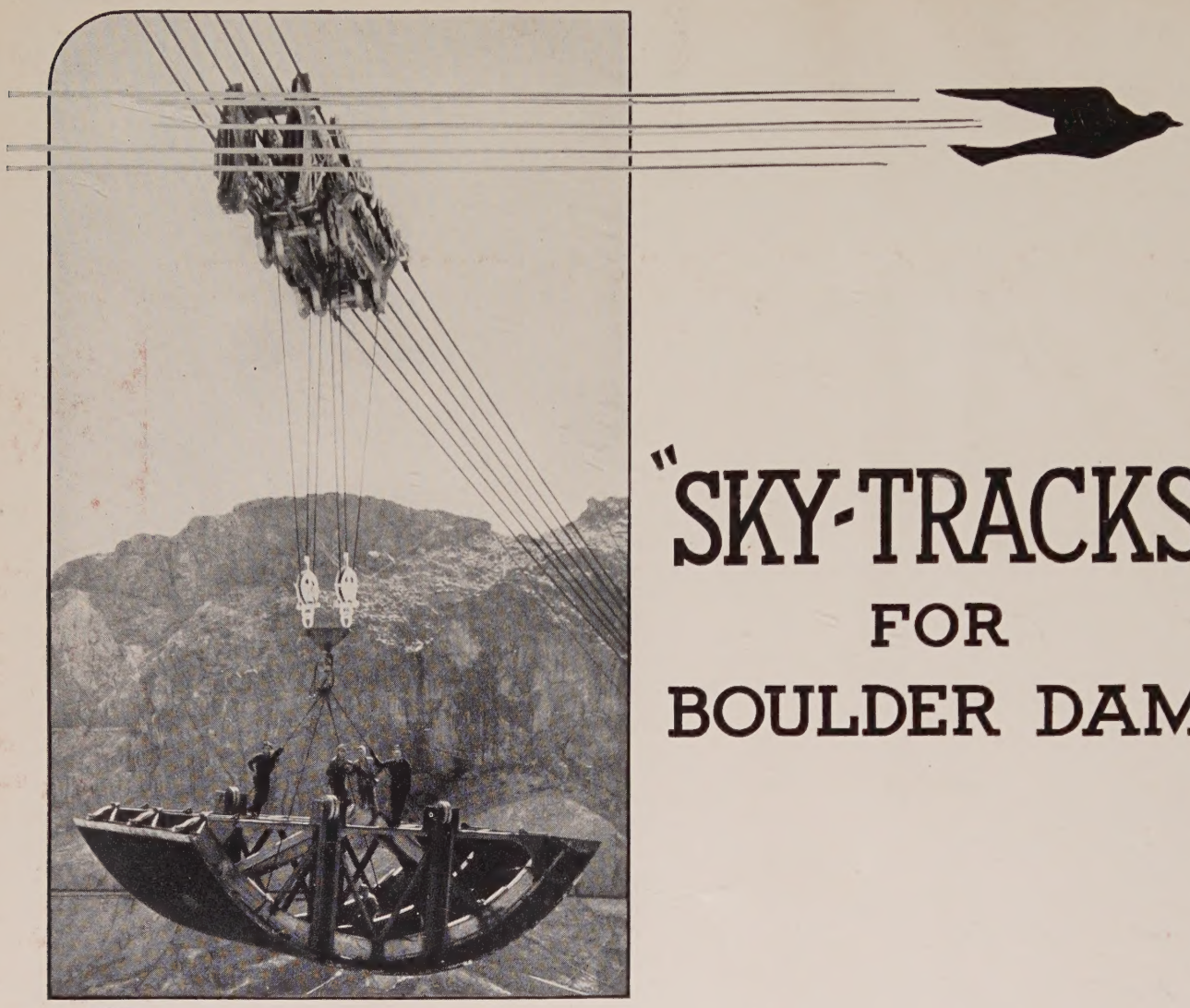

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Concrete Is Published in Two Editions

REGULAR EDITION—The Regular Edition of CONCRETE is edited for everyone who uses concrete in any form in his business. Its pages are devoted to topics of interest to the contractor; the engineer, the architect, and the concrete products manufacturer; and to recording the development of the concrete industry. It covers the design and construction of concrete buildings, bridges, streets, highways, and other structures, and the manufacture of concrete products of every type. The subscription price is $3.00 a year in the United States, its possessions, and Mexico. Fifty cents additional for duty in Canada. One dollar additional for postage in all other countries. Current copies, 40 cents each.

CEMENT MILL EDITION—The Cement Mill Edition of CONCRETE is edited exclusively for those interested in the manufacture of portland cement and related products. Its pages are devoted to the discussion of plant design, management and operation, production efficiency, chemical research and control, quarry operation, the progress of the industry, and other topics of news and development. The Mill Edition also contains all the material published in the corresponding issue of the Regular Edition. The subscription price is $4.00 a year in the United States and its possessions, and Mexico. Fifty cents additional for duty in Canada. One dollar additional for postage in all other countries. Current copies, 50 cents each.

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Established 1904

Concrete

Volume 42 — June, 1934 — Number 6

NORMAN M. STINEMAN, *Editor*
J. C. WITT, *Consulting Editor*

NRA MEMBER U.S. WE DO OUR PART

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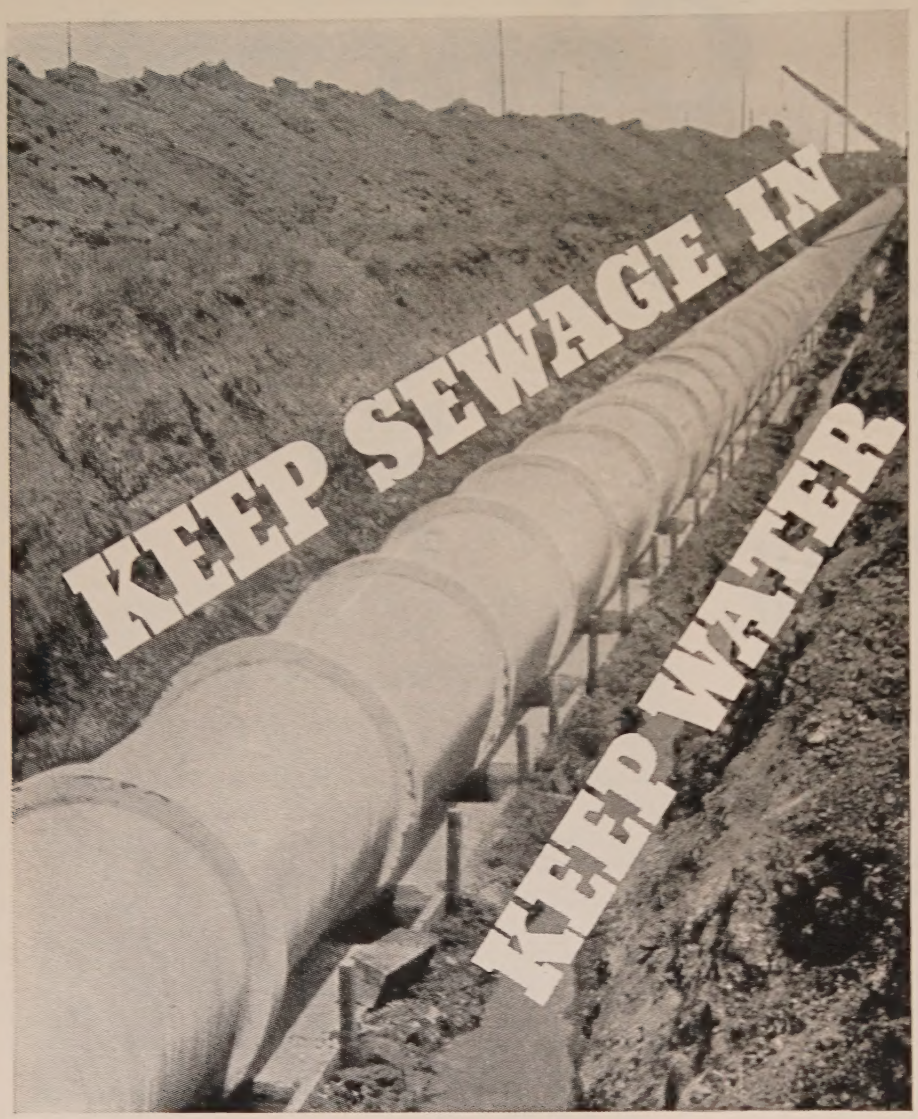

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Please say, "I saw it in Concrete"

Vol. XLII, No. 6 **Concrete** June, 1934

Milwaukee Sewage Disposal Project Is Model of Construction

Most Modern Methods and Equipment Employed on Huge PWA Contract—Pump 52,000 Yards of Concrete for Distances Up to 990 Ft.—Handling Material at Mixing Plant—Wall Form Panels Given Many Re-Uses

ONE of the major construction projects financed through the aid of the federal Public Works Administration is the huge sewage disposal plant addition now under construction on Jones Island, Milwaukee, Wis.

Most Modern Methods and Equipment

A significant feature of the Milwaukee project is seen in the fact that the most modern methods and equipment are being employed in its construction.

For instance, sand and gravel are received by rail from North Lake, Wis., in gravity-unloading hopper-bottom cars, dumped directly into track pits, and transferred either into aggregate bins or stock piles by a crawler crane and clam-shell bucket.

Cement is shipped in bulk from Manitowoc, Wis., in hopper-bottom gravity-unloading railway cars designed especially for the transportation of finely pulverized bulk material. The cement is discharged into a horizontal screw conveyor which, in turn, discharges into the boot of a bucket elevator, in which it is conveyed to the metal cement storage bins of the concrete mixing plant.

At the central concrete mixing plant all materials are proportioned by weight, and the concrete is distributed through a 7-in. pipe line over the entire construction area of eight acres by a double-unit concrete pump—in itself a recent and highly successful development.

Form work for the series of long channel walls and aeration tank walls is erected and assembled in large standardized units, made of wood, and the concrete is placed within the walls under the action of internal vibrators of high frequency.

No Place for Primitive Methods

The use of these modern methods and efficient construction equipment on this project has again demonstrated the fallacy of the thought that large construction projects can be built without modern equipment. So recently as the summer and autumn of 1933, occasional announcements from the PWA heads in Washington carried the disquieting implication that the least possible amount of construction machinery was to be employed on projects financed in part by PWA funds. Fortunately, the waste and inefficiency involved in such a policy has been avoided.

The Jones Island sewage disposal plant extension at Milwaukee covers about eight acres. It involves the placing of 52,000 cu. yd. of concrete and 3,168 tons of steel reinforcement, together with numerous accessory details. The project was started on September 19, 1933, and it is expected that the placing of concrete will be completed in July of this year.

Foundation Slab on Piles

A heavily reinforced concrete foundation slab, more than 2 ft. thick, covering more than 8 acres, and containing 22,000 cu. yd. of concrete, is supported on 20,000 piles spaced approximately 5 ft. in each direction. The slab is reinforced by a double mat of bars, in top and

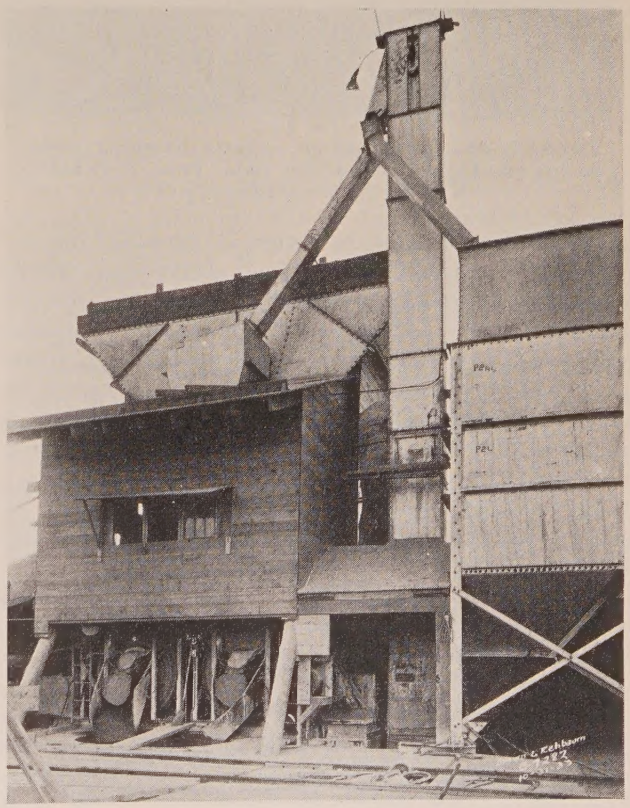


Figure 1. Concrete mixing plant, showing two 1-yard mixers discharging into 4-yard hopper set in floor, which in turn feeds the concrete pump set on a lower level

bottom, each mat consisting of 1-in. bars spaced 12 in. each way. This enormous volume of concrete was placed in 20 working days of 24 hours each, operations having been carried on continuously for 5 days each week.

Central Mixing Plant

The central concrete mixing plant is the principal feature of the job layout, while the concrete pump (an important unit of the central plant) may be regarded as the heart of the whole project.

At the central plant, as previously stated, the cement, the sand and the gravel all are received by rail, in hopper-

Figure 2. Discharge end of concrete pumping system during placing of foundation slab. Final distribution is made by a swinging chute

bottom cars. So far as the cement is concerned, the only difficulty experienced was that of obtaining a sufficient number of the special railway freight cars required. Unfortunately, very few railroads have equipped themselves with even a small number of these hopper-bottom gravity-unloading cars designed for transporting bulk cement and other dry pulverized commodities. Fifteen cars were assigned to this project during the period of peak production of concrete. They were borrowed from the Pennsylvania Railroad. By prompt loading and unloading, and starting the cars on their way without delay, they have been able to keep the job supplied.

At the plant the cement is discharged into a horizontal screw conveyor set underneath the rails and between two ties, a canvas hood having been arranged to connect the car with the conveyor housing. The screw conveyor discharges directly into the boot of the vertical bucket elevator shown in Figure 1, through which the cement is elevated to a 72-yd. storage bin above the concrete mixers. From the large storage bin the cement is fed to the weighing batcher from a small auxiliary storage hopper and through an automatic cement-weighing device.

Sand and gravel are of a very high quality, both well graded from smaller to larger sizes. The gravel sizes run up to 1½ in. Concrete for the foundation slab was proportioned so as to contain 5 sacks of cement to the cubic yard of concrete in place. For the walls the cement content is 6 sacks to the cubic yard.

Two 1-yd. Rex mixers are employed in the mixing plant, the concrete being mixed 2 minutes and then discharged into an open hopper above the concrete pump. This hopper has a capacity of 4 cu. yd.

Pumping Concrete a Thousand Feet

From the 4-yd. hopper the concrete, which has a slump of about 4 in., is fed into the double-unit concrete pump, known to the trade as Rex Pumpcrete. The pump is driven by electric power, although gasoline-driven units are also available. An electric signal arrangement permits the foreman at the point where concrete is being placed to stop the pump in an instant.

The concrete is pumped through a 7-in. pipe line for a maximum horizontal distance of 990 ft. on this project, though even greater distances have been attained on other projects. During the time when the heavily reinforced concrete foundation slab was being concreted—the slab containing 22,000 cu. yd. of concrete—the pump was operated continuously, 24 hours a day. The maximum day's concreting during that time was 1,236 cu. yd., or 51.5 cu. yd. an hour. The slab was concreted in 20 working days of 24 hours each, so that the average daily volume of concreting was 1,100 cu. yd., or about 46 cu. yd. an hour. In recent months the walls are being concreted, and the rate is about 38 cu. yd. an hour.

The efficiency of this concrete pumping system is well illustrated from its performance during one week while the heavy concrete foundation slab was being placed. Pumping was continuous — 24 hours a day — from 6 o'clock on Monday morning to 10 o'clock on the following Saturday morning, with the single exception of a shut-down of 1½ hours for reasons not in any way connected with the pumping equipment.

During this period of 24-hour operation an electrically operated flood-light system kept the construction site well lighted.

Placing the Concrete

Figure 2 shows the discharge end of the concrete pumping system during the placing of the heavily reinforced

Figure 3. The distributing chute was moved along the wall, starting from the far end, by disconnecting the farthermost sections of the pipe line

concrete foundation slab. The pipe line, as seen here, discharged into a swinging chute that carried the concrete to the final point of deposit.

A similar method of final distribution was employed in concreting the walls. Another illustration (Figure 3)

shows how the final distributing chute was shifted along the wall. The pipe line was put in place to the far end of the wall to be concreted. The pipe line consists of 10-ft. sections, fitted at each end with a flange and a rubber washer. The sections are firmly joined by means of couplings of the toggle type.

As the concreting proceeded from the far end of the wall, the farthermost sections of pipe were disconnected and the distributing chute was moved in to the new point of discharge. This operation was repeated as soon as the

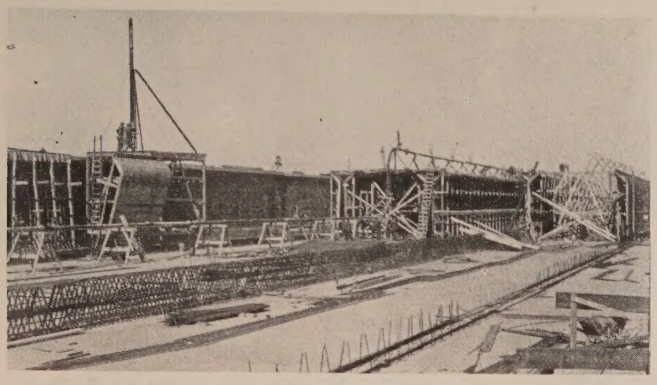


Figure 4. Concreting the aeration tank walls. At left, a standard panel of wall form is being placed in position

wall within reach of the chute was filled. In the meantime the released sections of pipe were shifted laterally to the next position of the pipe line. More recently, specially designed valves have been placed in the pipe line, eliminating the necessity of taking down and erecting pipe sections during concreting operations.

Internal High-Frequency Vibrators

Because of the great depth of the aeration tank walls and other walls in this project, and the heavy reinforcement in them, internal high-frequency vibrators with long flexible shafts are employed in placing the concrete. Two different makes of vibrators are being used in this work, both giving excellent service. The use of these vibrators partially eliminates the need for puddling by hand. At the same time the concrete is compacted to a far higher degree than would be possible with hand-puddling under the difficult conditions encountered.

An excellent finish is applied to the walls, which present a straight and smooth appearance when the form panels are removed. Rough places are ground down with motor-operated grinding wheels known as the Mall surfacer. After this the walls are lightly rubbed by hand.

Work 30 Hours Per Week

While the foundation slab was being placed, four shifts of men working 6 hours each were employed. At all times the work has been carried on under the regular PWA schedule of 6 hours a day and 5 days a week. Except for runs of concreting that may extend over into Saturdays, operations are closed down on Saturdays and Sundays. Work is started each day at 6 A. M. and is continued without interruption during two 6-hour shifts.

Acknowledgements

The Jones Island sewage disposal plant construction was designed by the engineering department of the Milwaukee Sewerage Commission, of which Darwin W. Townsend is acting chief engineer and Walter W. Genrich is assistant to the chief engineer. J. A. Maiers is resident engineer on the project. The concrete mixers and the concrete pumping system and accessories were supplied by the Chain Belt Company, Milwaukee, while the steel storage bins for cement and aggregates, and the cement and aggregate weighing batchers were supplied by the Butler Bin Co., of Waukesha, Wis.

The contract is held by G. R. Fehr, Inc., General Contractor, Milwaukee, and is being performed by the combined organizations of G. R. Fehr and the Kramp Construction Co., Berlin, Wis. Grant M. Hinkamp, of Milwaukee, is general superintendent for G. R. Fehr. A. J. Kramp represents the Kramp Construction Company.

Heavily Traveled Concrete Roads Low in Maintenance Cost

Minnesota Reports Their Upkeep Charges Much Less Than Roads of Lightly Traveled Treated Gravel

CONCRETE trunk highways, carrying the heaviest traffic, require the smallest maintenance expenditure, according to Minnesota state highway department figures published in *Highway Research Abstracts* for April, 1934. Maintenance of concrete slabs in 1931 averaged $97.61 per mile. This included crack filling, lifting sags with a "mud jack," and replacing broken spots in the older pavements. Adding shoulder repair, snow removal, mowing, repair of ditches and culverts, signs and miscellaneous, the total expense averaged $249.36 per mile. The paved routes carried an average of 2,309 vehicles per day.

Gravel roads, with less than one third as much traffic, cost more to maintain. The average cost of maintaining 2,948 miles of untreated gravel road was $339 per mile for all items except regraveling. The maintenance division regraveled 1,601 miles at an average cost of $256 per mile.

The more heavily traveled gravel roads were bituminous-treated. The average cost per mile of 1,589 miles of new treatment or retreatment was $1,069. There were 291 miles of bituminous gravel on which retreatment was not required. These showed an average expense of $176 per mile for maintenance of the roadway, and a total of $280.60 per mile with snow removal, roadside maintenance and all other items.

Uniform Practices for Concrete Aggregates Industries

NATIONAL Recovery Administrator Hugh S. Johnson has approved, effective May 13, uniform terms of sale and uniform credit practices for Districts 1, 2, 3 and 4 of Region No. 9 of the crushed stone, sand and gravel, and slag industries. These four districts combined include the two states of Illinois and Indiana.

The terms of sale, identical for each district, provide that before a producer sells or offers to sell within the district any of the products of the industry he shall file prices with the office of the district committee.

One of crew of 5,000 CWA workers laying concrete paving in Detroit car tracks in zero temperatures

Lay Street Railway Paving Concrete in Zero Weather

Procedure Followed in Detroit Points Way to Continuous Concrete Street Paving in Winter Months—Work Organized to Defy Weather

This story of successful concrete street paving work in Detroit during the extremely cold weather of the past winter adds further strength to the growing realization that concrete paving work may be continued throughout the winter months.

With this evidence added to methods of procedure described in other recent issues of "Concrete," particularly in the January, April and May numbers, the duty of state and county highway departments becomes clear. That duty can be fulfilled only through the establishment of a year-round construction program—and NOW is the time to organize that program.—Editor.

A PRACTICAL solution to the problem of placing concrete pavement in cold weather may have been found in the past winter's experience in placing concrete street car track pavement base, under direction of P. A. Kerwin, superintendent of way and structures, Detroit Street Railways.

Proceeding during the exceptionally cold months of January and February, a force of 5,000 CWA workers paved 24 miles of street car track (12 double track miles) during weather averaging 26.3 deg. F. Temperature ran as low as 15 degrees below zero. The entire project was organized with the idea of continuing work regardless of weather, and in accordance with established CWA hours.

Average strength of cores at 28 days was 3,056 lb. per sq. in. as contrasted with the minimum requirement of the Detroit Street Railway standard specification of 2,500 lb. per sq. in. No evidence of frost damage to the concrete was found.

Water and Aggregates Heated

Contrary to customary winter paving practice, the subgrade was neither protected from freezing prior to placing the concrete nor was the frozen layer removed. In advance of placing concrete in the trench (usually the night before), a strong sodium chloride solution was sprinkled over the bottom of the trench to draw the frost out of the subgrade surface. A steam shovel boiler supplied water at 100 deg. F. to the mixers. Materials were delivered in two and three-batch trucks, arriving on the job at an average temperature of 40 to 50 degrees. Concrete was mixed approximately 1½ minutes and, when placed on the subgrade, was at an average temperature of from 60 to 70 degrees.

Fresh Concrete Protected

The concrete was immediately rammed and tamped to full bearing under the ties and levelled down. Within 15 minutes after placing, it was covered with 3 in. of damp marsh hay upon which was placed 6 in. of fine, close-packing sand.

The purpose of these precautions was to retain the heat which had been applied to the concrete and to retain the

heat generated by hydration of the cement. The covering also cut off drying action.

On February 7, with a temperature of 10 degrees below predicted for the next day, it was deliberately decided to go ahead with concreting, and 50 ft. of double-track paving was placed on three jobs. Mean temperature on the 8th was 4 degrees below zero and within 24 hours the thermometer reached 15 below. Six cylinders, two from each job, showed an average of 2,928 lb. per sq. in. at 28 days. No frost was evidenced in 41 test cores, including the six just mentioned.

An experiment conducted by a government engineering inspector showed what happened following placing and covering of the concrete in this sub-zero weather. On February 7 he had a box built about 14 in. square, open top and bottom. He set this box on the frozen subgrade. Mean temperature as of this date was 16 degrees. The subgrade had been frozen to a depth of 24 in. The box was placed about the middle of the afternoon and was filled with concrete as part of the track base.

Temperature on the following day averaged 4 degrees below zero. The box was removed at noon, revealing that the subgrade was thawed out to a depth of 6 in. below the concrete. Mr. Kerwin points out that water for proper curing of the concrete was retained in the concrete by the damp hay covering and by the moisture in the thawed subgrade.

Three units, consisting of two concrete paving mixers each were used on this job. The concrete was of the standard Detroit Street Railway specification—1:2½:4 parts by volume. No admixture was used. More than 66,000 tons of aggregate and 60,110 bbl. of standard portland cement, in addition to rails and thermit portions for welding rail joints, went into this street railway modernizing program. The project illustrated, also, the excellent work that may be accomplished with mixed crews of trained and untrained but intelligent men of the type that constituted these CWA workers.

Place Concrete Pavements in Winter in Illinois

Joins Other Northern States in Developing Construction Procedure for Cold-Weather Operations

ARTICLES printed in several recent issues of CONCRETE, including the present issue, describe the placing of concrete road and street pavements during winter in northern states such as Ohio, Indiana and Michigan.

In these articles, as well as in editorials in CONCRETE, directors of state and county highway departments have been urged to lay plans now toward the continuance of concrete paving work throughout next winter.

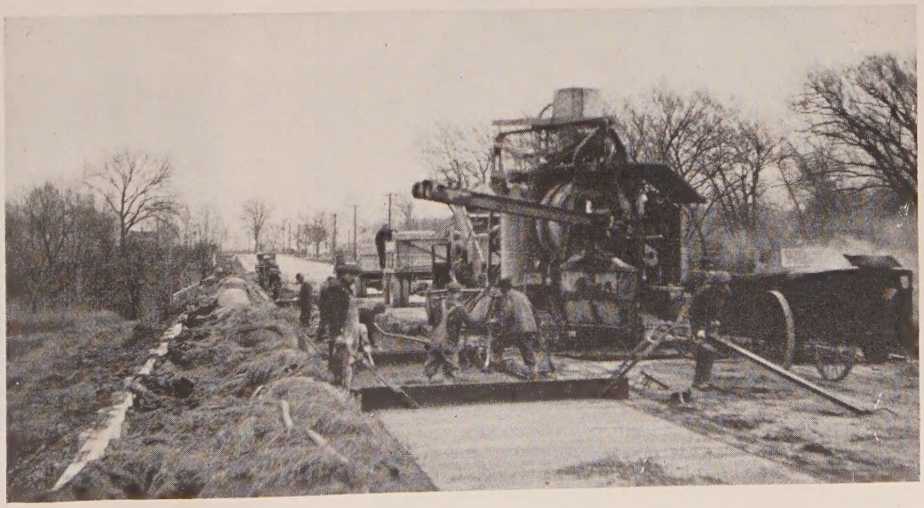
The paving scene here illustrated shows that Illinois, another state that has cold winters, has broken away from the erroneous idea that concrete paving must stop when cold weather comes. This view shows the progress of winter concrete paving work in Touhy Avenue, Niles Center, Ill., in the Chicago metropolitan area. The Touhy Avenue contract involved the placing of 8,007 sq. yd. of concrete pavement of 10-8-10 cross-section, and 6,570 lin. ft. of curb and gutter.

The Construction Procedure

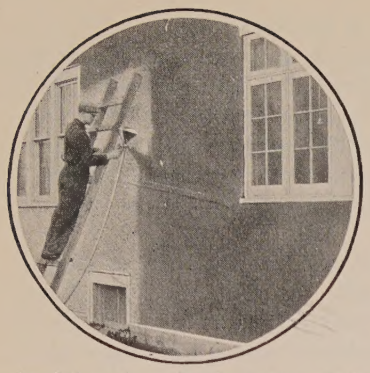
Briefly stated, the construction procedure included, first, the heating of the mixing water. Aggregates were not heated unless they were actually frozen.

The subgrade was prevented from freezing by keeping it covered with straw. This straw was removed in time to permit rolling of the subgrade just before placing the concrete. An oil-burning mixer heater was employed to bring the temperature of the concrete to 70 deg. F. as it was placed on the subgrade, where it was spread and finished in the usual manner. The concrete was then promptly covered with burlap, and then with loose straw to a depth of 1 to 2 ft.

The heat in the concrete, plus the heat generated during the hardening process, kept the concrete warm under the burlap and straw until it had attained its full strength, after which the covering was removed.



Concrete pavement placed in Touhy Avenue, Niles Center, Ill., last winter was spread and finished, then covered with burlap and straw



Applying the plastic spray coat of colored cementing material

Coat of Colored Cementing Material Restores Old Stucco Residence

Plastic Coloring Material Applied by Portable Spray Machine—Applicable to All Kinds of Masonry—Opens Wide Field for Renovating and Remodeling

THE nation-wide campaign to stimulate housing by creating government-supported means through which the renovating of old houses and the construction of new ones may be financed has received definite help and encouragement from Washington. The President, on May 15, sent a message to Congress urging the adoption of a housing plan.

Regardless of how important the governmental stimulant may become, housing construction will assuredly play an increasingly important part in the nation's economic recovery. There is ample reason to believe that lack of financing is the one great obstacle that is preventing an upward surge in house building. In consequence, if congressional action can in fact break this obstruction, private enterprise will be enabled to perform its normal functions.

Renovation to Play Important Part

The renovation or remodeling of old houses, in the opinion of many construction people, will in turn constitute a considerable part of any home building activity that may develop. The former tendency to tear down the old and build the new is not so prevalent today. The tendency is, rather, to save all of the old that is worth saving, and then to modernize it. Much credit for the creation of this tendency toward renovating and modernizing belongs to the Portland Cement Association and other manufacturers' organizations, who have disseminated vast quantities of information on the subject—in forms which the average person can grasp.

Color and More Color

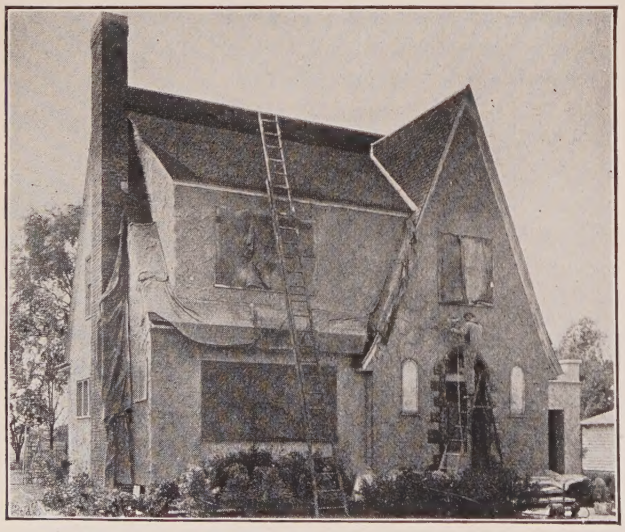
Home owners have, likewise, become conscious of the value and desirability of color, on both the exterior and the interior of dwelling houses. The Century of Progress Exposition in Chicago has been a powerful influence in this respect—an influence that will be lasting.

In this matter of color, the owner of an old stucco or masonry home need not be without it; and it is here, in the renovation or overcoating of old stucco and masonry exteriors, that architects and stucco contractors—especially the latter—may find a large field of operations. The amount of equipment needed is not beyond the reach of the small contractor, and the possibilities are almost endless.

Six-Year Test Proves Permanence

Seldom has the truth of this assertion been demonstrated to better advantage than in the case of a comparatively old stucco home in Holland, Mich., here illustrated. One picture shows the work of renovation in progress, six years ago, while the other shows the attractive appearance of the building after completion of the work in 1928. The smaller illustration shows the portable spraying equipment in action on this work.

This house has been observed each year since its ren-



Left—Renovating old stucco house by applying plastic spray coat of colored cementing material. Right—The work completed, with new concrete tile roof added. After six years the house retains appearance of new building

ovation by a representative of CONCRETE, his last visit having occurred early in May of this year. The building is as bright and colorful as ever, and still has the appearance of a newly-built house.

The reason for the annual observation of this house by a representative of CONCRETE arises from the fact that the colored coating sprayed on the surface of the old stucco in 1928 was placed as an experiment—as a means of testing the permanence of the coloring material and the weathering qualities of the coating itself. The success of the experiment resulted in many other contracts of a similar character.

How Old Stucco Was Made New

The house here illustrated was selected for the experiment because the old stucco showed many checks and discolorations, and it has large surfaces exposed to the weather, with the south side receiving direct rays from the sun. No special treatment of the surface was made except wetting down with a hose before applying.

The surfacing material used was the highest grade of mineral color, cement and other ingredients, mixed according to a perfected formula, the result of years of research. These materials were all ground together in a special ball mill. To this mixture selected aggregates were added, screened to uniform size. All dust and fine particles were removed by passing through a No. 50 screen, and large particles were removed by a No. 12 screen. This mixture consisted of one part of cement to three parts of aggregate. After being thoroughly mixed in a dry condition it was taken to the job, where it was mixed as used.

Low Cost Suggests Big Opportunity

Due to the coarseness of the colored coating material, it was necessary to develop a special spray machine. The openings in the gun had to be considerably larger than the coarsest particles. With these large openings and coarse material the gun required a large volume of air at a constant pressure. Care was exercised in the amount of water used in order to obtain a mixture that would spray in a plastic form.

A helper was employed to mix the material wet and assist in moving the ladders for the operator. A careful record of this job disclosed that the actual time of the operator and helper totalled 14 hours, at a cost of $14.00. The job required 1,120 lb. of mixture, for which the material cost $16.80, bringing the total material and labor cost to $30.80. The house measured 280 sq. yd. of surface. Thus the total cost of color resurfacing was 11 cents per sq. yd. for material and labor alone. This remarkably low cost suggests at once that here is a very promising opportunity for stucco contractors.

The owner of this house decided to put on a new roof of concrete tile, and as a further test for this coloring material the roofing tile was sprayed with the same material in several shades of green. The result was a very pleasing variegated roof. The concrete roofing tile were laid directly over the old wood shingles without any special preparation.

Architects and Concrete Men Interested

Now, after six years of exposure to severe winters and extreme heat in summer, both the side walls and the roof have retained their original beauty and show no checks or cracks. During these years scores of architects and experienced concrete men have inspected this job and have commented most favorably on the permanency of the color and the surface. It is believed that the durability of this resurfacing was due to the coarse aggregate used, to the high quality of the mineral colors employed, and the successful spraying of a plastic mixture.

Since this original experimental contract was completed, the same character of colored coating material has been successfully applied on all kinds of masonry surfaces all over the country. Types of masonry to which the coating has been applied include portland cement stucco, magnesite stucco, and clay brick.

Acknowledgment: Colorcrete Industries, Holland, Mich., is the company that manufactured the material and developed the process here described. This company also arranged this experimental work as a practical and convincing test of the material and method employed.

Code Exemptions for Small Concerns in Small Towns

May Affect Contractors and Concrete Products Manufacturers

PRESIDENT Roosevelt, on May 15, signed an executive order exempting small business and industrial concerns in towns of less than 2,500 population from compliance with provisions of codes of fair competition other than those covering child labor and fair trade practice.

Employers engaged only locally in retail trade or local service trades or industries, and operating not more than three establishments in towns of less than 2,500 population are exempted from those provisions of their code or codes which relate to hours of employment, rates of pay, the minimum prices at which products may be sold or services performed, and the collection of assessments. An employer so situated—for example, a concrete products manufacturer in a town of less than 2,500—would, presumably, not be allowed to sell his product in towns and cities of more than 2,500 population unless he actually does comply with the full provisions of the code. Intention to comply with the code may be filed with the Administrator of the NRA, at Washington.

Products manufacturers having plants in small towns, but who are within shipping distance of larger towns or cities, might find themselves in an unfortunate position if, because of non-compliance, they were to lose a chance to sell a large order in one of the larger cities.

Contractors located in small towns, however, are in an advantageous position as a result of this executive order. Presumably they can bid on local work on the basis of local wages—usually a low rate. When bidding on work in larger towns and cities they will, of course, be required to figure on the basis of the code wage scale.

Ohio Tests Show Vibrated Concrete Makes Stronger Pavement

Litehiser Report Discloses Test Results in Line with Usual Experience—Permits Use of Drier Mixture

R. R. LITEHISER, chief engineer of the bureau of tests, Ohio State Highway Department, has issued a report describing the test procedure, and results obtained, in an investigation of the effects of vibrating pavement concrete in advance of the finishing machine. The essence of the report is given in the May (1934) issue of *Highway Research Abstracts.*

The test section of pavement was on U. S. Highway No. 30 North, in Crawford County, Ohio. For the comparison of vibrated with unvibrated concrete, the following procedure was adopted:

The regular mix called for 6.3 sacks of cement per cubic yard of concrete, slump not more than 2½ in. Aggregates were crushed limestone and limestone sand hauled from a central batching plant to the mixer.

The vibratory finisher, arranged so that the screeds could be vibrated or not vibrated at will, was used ahead of the ordinary finisher on the test section. The remainder of the job was finished with the ordinary finisher. The concrete was finished as follows: 7,204 sq. yd. with the ordinary finisher, 5,091 sq. yd. by the vibratory finisher with vibrators working and 2,213 sq. yd. with the vibrators not working. Cores were cut from vibrated and unvibrated concrete at 7 and 28 days and tested the same day as cut.

The table shows the mixes used, as well as the compressive strength of the vibrated concrete expressed as percentages of the regular mix, unvibrated.

TEST RESULTS—EFFECT OF VIBRATING PAVEMENT CONCRETE

Mix No.	Proportions Dry, Loose by Weight	Per Cent Sand	Cu. Ft., Absolute Volume per Cu. Yd. Concrete Cement	Cal-culated Water	Compressive Strength, Percentage of Regular Mix Strength 7 Days	28 Days
Regular	1-2.34-3.42	40	3.15	4.12	100	100
Special No. 1	1-2.18-3.62	38	3.15	4.15	-----	-----
Special No. 2	1-2.13-3.70	37	3.15	4.15	-----	
Special No. 3	1-2.08-3.76	36	3.15	4.03	132	122
Special No. 4	1-2.02-3.86	34	3.15	3.90	124	
Special No. 5	1-1.98-3.94	33	3.15	3.78	122	119
Special No. 6	1-1.82-3.94	31	3.15	4.34	111	112
Special No. 7	1-2.37-4.51	34	2.75	3.75	88	94

The use of the vibrator made it possible to use a drier mixture than with the regular finisher. The report gives this as the probable reason for greater compressive strength in the vibrated concrete. The average compressive strength of the vibrated concrete was 13 per cent above the regular concrete strength. The vibrator made spading along the forms unnecessary. There was no objection to the vibrated concrete by the laborers who placed and finished the concrete.

The President's Plan to Promote Home Repair and Remodeling

Bureau of Foreign and Domestic Commerce Conducts Survey—62 Per Cent of Homes Need Repairs

THE theory of the President's new plan to promote home repair and remodeling is to ask Congress to authorize a mortgage guarantee corporation to ease private borrowing by home owners. The government would guarantee the loans without lending the money. The proposed corporation, linked closely with the Home Owners' Loan Corporation, would determine whether loans were justified, then guarantee the mortgages of lenders. The new effort is expected to be directed by the National Emergency Council, headed by Frank C. Walker. For months this council has been engaged in the study of home and housing problems.

Indiscriminate loans will be restricted by the fact that all lenders will have to meet government requirements. Banks and building and loan associations, and other loaning agencies, may seek government guarantees, but the fact that all lenders will have to meet government requirements as to the worth of the loan will tend to restrict indiscriminate loans.

This proposed housing program, which contemplates only repairing and remodeling work, has been developed by the administration following a White House conference on April 19, it was announced, and it is expected that it will be ready to be put into effect very soon. Plans are being worked out whereby the Reconstruction Finance Corporation may insure loans made for home remodeling and repairs without additional authorization from Congress. If a satisfactory method can be found without legislation, the President has indicated that machinery to release a vast reservoir of unused credit estimated as high as $1,500,000,000 will be put to work at once.

Impetus to the projected housing campaign is given by a survey being conducted in 63 cities by the Bureau of Foreign and Domestic Commerce known as the "Real Property Inventory." This survey shows that 62 per cent of American homes need repairs. Although not completed, the facts covering eight cities have been issued by the bureau.

EDITORIAL

Sewage Disposal Gains Public Interest

THE Milwaukee sewage disposal construction project, financed in part by the PWA, is an excellent example of what may be accomplished in the field of sewage disposal. This plant, described in an article in this issue, is designed as an extension to an existing plant that long ago proved its value, not alone as a health measure, but an economic measure.

Literally hundreds of similar disposal plants, most of them in cities much smaller than Milwaukee, were approved by the PWA and allotments were set aside for them. Some of these have been completed, others are under construction, while still others are tied up in legal difficulties and have not been started.

It is to be hoped that cities of the last-named group will do everything possible to remove legal obstructions, in order that construction work may proceed. Further delay may result in cancellation of PWA allotments.

Undoubtedly one of the major permanent benefits to be gained from the PWA is the impetus it has given to the growing sentiment in favor of sewage disposal. No other advanced country in the world permits the pollution of streams and interior bodies of fresh water to the extent experienced in the United States. Years of educational work by state health departments and associations and by worthy organizations such as the Izaak Walton League have begun to take effect.

Regardless of aid from the federal government, state and city health and engineering officials should take advantage of the increasing public interest in sewage disposal, by directing this interest in a manner that will lead eventually to a sewage disposal plant for every city and town.

When the people of a community realize that sewage disposal is as important as the sewerage system itself, little time will be lost in providing this improvement for that community.

Concrete Products Win Small-Job Market

THE concrete products plant of A. W. Hays, at Joliet, Illinois, has been operating continuously since March, 1933, with the single exception of a shut-down of three weeks in January of this year.

During this time the plant has been turning out hollow concrete building units, plus some specialties such as manhole block and concrete silo staves. The hollow building units—more especially the 8 by 8 by 16-in. block—constituted by far the greater part of the business.

In a word, this plant was in profitable operation during the greater part of 1933, the year when construction work reached its lowest level. This plant activity was not due to some lucky break, such as a large government contract. In fact, not a single large order was sold. Instead, the business came from the small private job, repeated many times.

Small orders were sold to the man who wanted a new foundation under his house, to the man who built a new garage or repaired his porch. Even farm owners were in the mood to build extensions and make repairs, and many a small order came from that source.

There may be several reasons why A. W. Hays has kept his plant busy supplying the small-job market; but the most obvious reason why he has accomplished this seemingly impossible thing is that he went after that market. He felt certain that such a market existed, and he left no stone unturned in his efforts to develop it.

What Hays has done, others can do—if they apply themselves to the job with equal diligence and intelligence.

Can't Build Without Modern Equipment

A TOUR of visits to construction projects where dams are being built for the Government, or where sewage disposal plants and other municipal improvements are coming into being through the stimulant of PWA loans, discloses the use of the most modern equipment available to the concrete construction industry.

Cement and aggregates are coming in bulk, direct from mills and pits, in gravity-unloading hopper-bottom railway cars. Concrete mixing plants are supplied with the most modern conveyors, bins, and batching devices. Concrete is being pumped through long pipe lines, or distributed by belt conveyors.

Less than a year ago some government officials in Washington were announcing that construction projects financed in whole or in part by the federal government were to be built largely by hand-labor methods. These announcements were made under the erroneous belief that such methods would create more employment.

Now those officials know that large and complicated construction projects can not be built without modern equipment. They know now that for every man employed on modern construction work, three or four men are employed in building, producing and transporting the equipment and materials that the construction man uses.

The whole recovery program suffered a distressing delay because it took government officials almost a year to learn these simple facts.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Curing Concrete Pavements

A REPORT by F. C. Lang, chairman of the Highway Research Board's committee on curing of concrete pavements, presented before the last annual meeting of the board, summarizes the information concerning various factors of the curing problem that has become available in the last two years.

The results of studies on the following topics are presented: (1) The factors that influence the efficiency of sodium silicate surface curing. Data from experimental projects in Missouri and Louisiana are included. (2) The factors that influence the efficiency of integral calcium chloride as a curing agent. This covers recent experimental work, reviews of published data and the work of a fellowship at the U. S. Bureau of Standards. (3) A study of conditions which may obviate the tendency of pavements cured with bituminous coatings toward more shrinkage cracks than in the case of those cured with wet earth; also the effect upon volume change and shrinkage cracks of covering the bituminous coatings with a whitewash or light colored powder. (4) Further studies on the effects of intermittent curing.

Standard Samples of Portland Cement

THE U. S. Bureau of Standards has added samples of portland cement to its list of available standard samples prepared for comparative test results.

Listed as sample No. 114, these cement samples are intended primarily for use in turbidimetric measurements of the surface area of cement (See A. S. T. M. *Proceedings*, Part II, 1933, page 553). The cement in the standard samples has a surface area of 1,900 sq. cm. per gm., and it leaves a residue of 12.3 per cent on a 325-mesh sieve when tested by the wet method.

The charge is $1.00 for a sample of 35 grams. Payment must accompany the order, the former practice of sending samples C. O. D. having been discontinued.

A complete list of standard samples, analyses and fees is given in Bureau of Standards Supplement to Circular No. 398, a copy of which may be obtained free by addressing the U. S. Bureau of Standards, Washington, D. C.

Vibratory Method of Finishing Concrete Pavement

THE MAY (1934) issue of *Highway Research Abstracts* describes briefly the results of tests conducted by the Illinois Division of Highways to determine the possibilities of utilizing a vibratory finishing machine on concrete pavements. Full details are given in Report No. 33-I of the Illinois Division of Highways, Springfield, Ill.

For the purpose of this investigation a test section of 20-ft. concrete pavement, 4,969 ft. long, was built near Fisher, Ill., in 1933. The machine was a double-screed Lakewood. The front screed carried four electric vibrator units and the rear screed carried two units. The screeds were operated in the regular way, the vibratory motion being imparted to them while in action. The test section was made up of 114 individual sections of about 45 ft. each, covering three series of progressively changing mixes for both gravel and crushed stone coarse aggregate. In one series, the water was the major variable, in one the coarse aggregate, and in one the fine aggregate. The mixtures were varied to determine the practical limits of the machine in finishing dry, oversanded, and overstoned mixtures. The report contains a detailed description of the construction and tests, tables of data and figures, and several photographs.

Satisfactory pavement was obtained from most of the mixtures, even the harshest being placed satisfactorily. The most suitable mixtures had about one-half inch slump and had a ratio of sand to total aggregates by absolute volumes of 32 per cent for gravel and 35 per cent for crushed stone. With this method of finishing, higher strength was obtained with the same cement content as the regular mixture, or the same strength as the regular mixture was obtained while reducing the cement content approximately one bag per cubic yard of concrete.

Clay Coating on Gravel Aggregate Proves Detrimental

W. D. Beers, city engineer of Salt Lake City, Utah, reports to the Highway Research Board an instance of detrimental effects resulting from the presence of clay coating on gravel aggregate.

During the construction of a storm water conduit, a few loads of gravel, partially coated with clay, were delivered. The gravel was used in the concrete after being partly cleaned by spraying with water from a hose. A 7-day test cylinder from the concrete broke at 1,344 p.s.i. while the average of cylinders, made with clean gravel, was 2,600 p.s.i. at 7 days. The fractured surface of the cylinder with coated gravel showed that the clay prevented normal adhesion of the cement. The mixing time for the concrete was two minutes.

Rheological Properties of Cement and Aggregates

EXPERIMENTS made by E. C. Bingham and Markus Reiner, at Lafayette College, Easton, Penna., to further our knowledge of plastic yielding of reinforced concrete, are reported in the January (1934) issue of *Highway Research Abstracts*.

Beams of neat cement and others of cement and standard Ottawa sand were cast in steel moulds 2.27 cm. square and 83.8 cm. long. They were allowed to bend under their own weight between supports 76.1 cm. apart. The deflection curves generally start as parabolas with vertical tangents but beyond a certain point, the curves become linear. The mobility of the cement is much greater than that of the mortar and decreases with the degree of curing.

Getting Color and Texture Effects into Concrete Ashlar

By D. R. COLLINS
Assistant Manager, Cement Products Bureau, Portland Cement Association, Chicago, Ill.

THERE is nothing standardized or iron-clad about attaining either color or texture in concrete ashlar work.

Color, for instance, may be obtained by the use of mineral colors mixed intimately with the cement used in the manufacturing process; or by using mineral colors in a similar manner in a facing mixture; by painting or staining the face shell of the ashlar units after they are cured, but before they are placed in the wall; or by applying paint or stain after the wall is laid up. These various methods will be discussed in more detail later in this article.

How Texture Is Attained

Concrete ashlar masonry in its present form originally was developed to a great extent with the use of light-weight aggregates. While light-weight aggregates such as cinders, processed slag, or burned shale or clay, are much to be preferred, because of the rough texture and sound-deadening value of products made from them, heavier aggregates may also be used. In many cases a very attractive texture may be obtained with sand and stone or gravel aggregates by screening out the extremely fine sand and using proportions so that there will be an excess of the larger particles of the coarse aggregate. In a word, architects and products manufacturers who are looking into the possibilities of concrete ashlar—each from his own point of view—need not be discouraged if no commercial light-weight aggregate is available in their respective communities.

Creating a Rough, Uneven Texture

Alfred Hopkins, an eastern architect, has developed quite an original and distinctive method of producing interesting texture in the exposed faces of concrete ashlar units. Alfred Hopkins and Associates have designed a number of concrete ashlar buildings, notable examples being the Berks County Prison* at Reading, Penna., and the Medium Security Prison, Wallkill, N. Y. As a result of his experiments, Mr. Hopkins learned that extremely interesting textures can be obtained by giving the exposed sides of the units, immediately after their removal from the molds, any one of the following treatments:

(1) Scrape the surface with a wire brush, a piece of wire lath, or a wad of burlap.

(2) Rub the surface with a sponge.

(3) Spray the surface with a fine water spray.

(4) Float the surface with a cork float.

Of course, the purpose of the treatments just enumerated is that of relieving monotony by creating a rough, uneven or irregular texture that helps to enhance the beauty of the finished wall.

At the Berks County Prison Mr. Hopkins had the units sprayed in various shades of color varying from light buff to dark brown, before they were laid in the wall. This is not the only allowable procedure. Some architects will prefer to paint or stain the units after they are laid in the wall.

Coloring the Individual Ashlar Units

As explained near the beginning of this article, there are three commonly used methods available for coloring concrete ashlar units before they are placed in the wall. These include, first, the use of mineral colors in the concrete in the manufacturing process; second, the use of mineral colors in a facing mixture applied to the face shell of the units immediately after their manufacture; and by applying acid stains or cement paint sprays to the face shell after the unit has been cured.

Interior random concrete ashlar coated with specially prepared cement paint

*See illustration of a portion of Berks County Prison on page 6 of the February (1933) issue of CONCRETE.

In Detroit and vicinity, where the present conception of concrete ashlar originated and where it has reached its greatest development, the prevailing practice is to paint the work after the wall is built.

Painting Ashlar Walls

Some excellent points on painting concrete ashlar walls were obtained by the writer in a recent interview with Roy McCandless, of the Detroit Cinder Block & Tile Co., Detroit. Mr. McCandless has probably followed through more concrete ashlar jobs than any other man in the United States, so that the methods recommended by him may well be regarded as good working procedure.

Weatherproofing should be one of the principal purposes of a painting coat on concrete ashlar, he said. For this reason he prefers to have the paint applied by a waterproofing concern rather than by the painting trade. A painter invariably tries to obtain a flat, smooth surface. A waterproofer, by contrast, thinks of the work as a waterproofing job, and with this idea in mind he covers the wall thoroughly and in a manner that produces a rather rough-looking job—exactly the effect the architect desires.

How Paint Is Applied

Paint is applied in several ways, but the use of an ordinary paint brush is not recommended, for the results are likely to be unsatisfactory.

Spraying will produce satisfactory results if the operator understands his business, Mr. McCandless asserted; but the products manufacturer who supplies the units would do well to discuss this important point with the architect. To obtain a good weather-proof job it is not sufficient simply to hold the spraying equipment at one angle and drag it back and forth across the wall, as when sprinkling a lawn. Instead, the nozzle should be held at different angles, so that the spray hits every point in the wall from four or five different slants. Only in this manner can every particle on the surface be covered and every surface pore sealed.

Getting Variation in Color

Further information on working procedure in the application of paint spray to ashlar units or walls is obtained from the experience gained with the units placed in Berks County Prison, previously mentioned. The color effects desired (and obtained) ranged from light buff to dark brown. After the units were cured they were sprayed with a high-grade cement paint. The paint reservoir was filled—let us say—with a medium brown color. When the reservoir was about half empty a quantity of light buff was added. This was followed by the later addition of buff, then finally, perhaps, by dark brown. The object was to keep a constant color variation, but to maintain a general autumn brown effect.

The method now favored and recommended by Detroit manufacturers is that of brushing the paint (or waterproofing) into the wall with an ordinary scrub brush. Careful work will leave every exposed particle on the wall surface completely covered with paint.

Water Paints Preferred

The practice in Detroit favors paints, prepared especially for treating concrete surfaces. As a general thing in the Detroit area, oil paints have not been satisfactory on exterior surfaces. On interior surfaces oil paint has a tendency to form a hard film on the surface, causing reverberation of sound, though it has been used to secure decorative effects on numerous jobs.

Water paints prepared for use on concrete have the advantage, when properly applied to exterior surfaces, of serving as a waterproofer as well as an attractive exterior finish. Scores of cases in and around Detroit, where such exterior treatments have been in place for five or six years and are still in excellent condition, testify to the value of good water paints. On exterior or interior work, cement paints must not be allowed to dry out too quickly. This is a point to be emphasized.

When applied to interior surfaces, water paint has the advantage that it takes away none of the sound-deadening value of the ashlar units. The interior treatment may be either one or two-tone work.

Personal Attention Is Imperative

Mr. McCandless urges every manufacturer of concrete ashlar units to take it upon himself to give his personal attention to every ashlar job he sells—to see that the painting, whether exterior or interior, is properly done. He can "make or break" himself in the concrete ashlar business by attention or neglect at this point. One poorly executed job does incalculable harm—more than a dozen satisfactory jobs can overcome.

A Warning About Tools

THE Cement Section of a recent *News Letter* of the National Safety Council, Incorporated, quotes the following from *California Safety News*. It is headed:

Mushroom-Headed Tools

"Many accidents occur because splinters fly from tools that have been allowed to become mushroomed on the striking surface. Recently a man was splitting old piles for firewood and was using a wedge, which examination showed had some small chips recently broken off. It was stated that the face of the hammer was also in bad condition, but whether the flying particle, which killed the man when it went through his jugular vein and windpipe, came from the hammer or the wedge, is immaterial. This accident would not have occurred had the wedge and hammer faces been in good condition.

"In industry, good tools are a necessity, and it is just as important that the faces be properly dressed as it is to have the cutting edges sharp. Look over your tools and see whether they are in the right condition."

California Rebuilds Quake-Damaged Schools with Concrete

RECONSTRUCTION of school buildings damaged by the southern California earthquake of March 10, 1933, has started in earnest with the recent letting of a contract at Norwalk for a reinforced concrete structural frame, and panel walls and interior cross-walls of the same material to replace shattered masonry. Many similar contracts are expected to follow this first award approved by the California State Division of Architecture.

New Block with Waterproofed Face Finds Prompt Acceptance

Oscillating Mechanism Attached to Block Machine Produces Dense, Waterproof Sides and End—Hays Plant at Joliet in Continuous Operation

THE new method of obtaining a non-porous, waterproof face on the exposed sides and ends of hollow concrete masonry units, developed by F. J. Straub and first described in the March (1933) issue of CONCRETE, page 23, is now in full production in the concrete products plant of A. W. Hays at Michigan and Benton Streets, Joliet, Ill.

The Oscillating Device

This new equipment, which creates a dense, waterproof face on the block, was installed in the Hays plant in April of this year and was put into production early in May. The installation consists essentially of two side

Part of storage yard of the A. W. Hays concrete products plant, Joliet, Ill. The stock piles on the left are the new oscillated face units

plates and one end plate, which are given an oscillating motion by means of an extension from movable parts of the automatic Anchor stripper to which the device is attached.

For the present the oscillating attachment has been fitted only to the mold for the 8 by 8 by 16-in. units, since this size constitutes by far the greater percentage of the output of the Hays plant.

Producing Dense, Waterproof Face

In operation the side plates, each 8 by 16 in. in size, have a rapid motion, both horizontally and vertically. The 8 by 8-in. end plate, used only for corner blocks, has only the up-and-down motion.

These plates, of course, are in direct contact with the concrete in the mold, and are operated continually—that is, the oscillating movement of the plates is going on while the tampers are in action and the concrete in the mold is under pressure because of the tamping. This results in a finished face consisting of a dense, waterproof paste, with pores all closed and with an attractive texture.

Product Accepted by Market

The new oscillated block is finding ready acceptance within the shipping area of this plant, since architects and contractors recognize at once the value of this additional treatment in the manufacturing process.

In the matter of quality, the Hays plant is turning out the highest type of product. Though located in a city requiring only the standard strength requirement of 700 lb. per sq. in. over the gross area, the units here produced are running from 1,200 to 1,400 lb. per sq. in.

Sand and Limestone Screenings

One policy of the management of the Hays plant—the purchase of none but the best aggregates available—has much to do with the resulting high quality of the units produced. Aggregate consists mainly of No. 3 limestone

Oscillating device attached to stripper machine produces dense, waterproof face on sides and one end of block

screenings and Lockport sand. The limestone screenings are obtained from the McCook quarries near Joliet, the stone itself being very hard and of high quality. Sand is mixed with the screenings. The very light grey color of

the limestone imparts a pleasing light grey to the finished concrete products.

Haydite aggregate is also used to some extent at this plant, especially for back-up units and similar purposes.

A Well-Equipped Plant

In addition to the automatic Anchor stripper, to which the oscillating mechanism is attached, the Hays plant is also equipped with a small Miles machine, a Monarch silo stave machine, and a Multiplex chimney block machine. The stripper turns out about 3 blocks a minute. The block capacity of the plant is about 2,000 standard 8 by 8 by 16-in. units daily. The entire plant is well arranged, stock piles are neat in appearance, and the storage yard is paved with concrete and is kept perfectly clean.

Perhaps the most surprising thing about the Hays plant is the fact that it has been in continuous operation since March, 1933, with the single exception of a shut-down of three weeks in January of this year. Certainly this fact bespeaks volumes for the energy and ability of the plant management.

Small-Job Market Keeps Plant Busy

Asked where his market lay, Mr. Hays replied that his sales all through 1933 and thus far this year were mainly for small, individual jobs. Even farm owners have bought a considerable volume of block for repairs and improvements to farm buildings. Some specialties are also sold, such as chimney block, concrete silo staves, and manhole block. The market is expanding and sales are increasing.

The disclosure regarding the large volume of sales in 1933, mainly to small jobs, in a year when statistical organizations were reporting extremely low construction volume, is of special interest to the concrete construction industry. This adds further support to the belief, often heard expressed, that during the last year and a half much of the construction work actually under way never appeared in published construction reports. This has occurred for the reason that most statistical organizations do not report construction projects below a certain dollar value, and numerous individual jobs were therefore too small to be included.

In Business Since 1903

Regardless of the soundness of this conclusion, Mr. Hays has uncovered the small-job market in his territory, and to this market he sold a large output of block—enough to keep his plant operating continuously with a force of 5 to 7 men.

Mr. Hays has been in the concrete products manufacturing business in Joliet since 1903, and is, in consequence, well acquainted with all branches of the construction industry in that territory. The oscillating equipment here described was installed by the Thos. W. Noble Co., of Chicago, representatives of F. J. Straub in the middle west.

Concrete-Paved Parking Spaces Bring Trade to City Retail Stores

Concrete Contractors See Opportunity—When One Store Provides This Accommodation, Others Must Follow

CONCRETE contractors see an opportunity in the need for concrete-paved parking areas to accommodate customers of chain and grocery stores, dairies, department stores, and other retail establishments.

Chain stores in particular—because they do not provide delivery service—are faced with the parking problem. Operating on a cash-and-carry basis, they must provide suitable parking space for their customers who drive cars. The parking area must provide an easy entrance and an easy exit; and above all, it must be paved. In a word, the accommodations must be equivalent to that provided at first-class filling stations.

The two views here illustrated show the extent to which this practice has developed in some cities—St. Louis and Indianapolis, in these two instances. The point of importance to concrete contractors is that when one store provides such accommodations, others are forced to follow the example or lose customers. In consequence, the contractor's opportunity is greatly widened when he has obtained his first paving contract of this character.

The large view shows concrete-paved parking space of the "drive-in" type at one of the Pevely Dairy Co. retail markets in St. Louis. The smaller picture illustrates a paved parking space around a retail store in Indianapolis

The Analysis of Fresh Concrete

Careful Test Procedure Necessary for High Degree of Accuracy—Two Methods Described in First Installment of Short Series

By WILLIAM A. BLANCHETTE
Highway Engineer, Division of Management, U. S. Bureau of Public Roads

In a series of three articles, of which this is the first, the author discusses the methods now employed in analyzing fresh concrete. He outlines a method of analysis that was successfully used in tests conducted at central concrete mixing plants by the division of management of the U. S. Bureau of Public Roads.

The next article describes the detailed test procedure.—Editor.

IN analyzing fresh concrete to determine the proportions of the ingredients contained in it, the total aggregate must be separated from the cement paste and then the fine aggregate separated from the coarse. It may or may not be necessary to separate the paste into its two components, cement and water, depending on the method of analysis used.

The Direct Weighing Method

Two methods are used for analyzing fresh concrete, the "direct weighing" method and the "weighing in air and water" method. In the first, the sample of concrete to be analyzed is weighed in air and then placed on a No. 100 sieve and flushed with water until all the material that will pass this sieve has been washed through. All of the water used in this washing process must be collected in a container. The No. 100 sieve is usually used for this separation because nearly all the cement will pass through and nearly all the fine aggregate will be retained on it. The fine aggregate is then separated from the coarse by passing it through a sieve with openings approximating in size the diameter of the largest particles of the fine aggregate. This is usually the No. 8 or No. 4 sieve. The fine aggregate and the coarse aggregate must then be either surface dried or dried to constant weight, depending on the weight basis used for the aggregates in the batch as a whole, and then weighed in air. The cement is reclaimed from the wash water by decantation. This residue is then either dried to constant weight and weighed in air or its air weight is obtained by the pycnometer method, as follows: $S = \frac{(W\text{-}P) \times \text{sp. gr. cement}}{\text{sp. gr. cement} - 1}$, in which

S = weight of cement
P = weight of pycnometer full of water
W = weight of pycnometer plus cement, plus sufficient water to fill pycnometer.

The use of the pycnometer method requires a specific gravity determination of the cement in the condition in which it exists in the concrete. The water is not reclaimed. Its weight is the difference between the total weight of the sample of concrete in air and the sum of the air weights of the cement and aggregates as determined.

Weighing in Air and Water

The second method of analyzing concrete involves the hydrostatic principle that the loss in weight of a body immersed in a liquid equals the weight of the liquid displaced. The sample of concrete to be analyzed is weighed in air. It is then weighed immersed in water. The sample is placed on a No. 100 sieve and flushed with water until all the material in the sample that will pass this sieve has been washed through. The cement is washed away and is not reclaimed as in the first method. After the washing process the fine aggregate is separated from the coarse aggregate on the proper size sieve and the immersed weight of each is obtained. The immersed weight of the cement equals the difference between the immersed weight of the sample and the sum of the immersed weights of the fine and coarse aggregates. These three immersed weights are converted to air weights by applying the following formula:

$$\text{Weight of a material in air} = \frac{\text{sp. gr.} \times \text{immersed weight}}{\text{sp. gr.} - 1}$$

The amount of water in the sample equals the difference between the air weight of the sample of concrete and the sum of the converted air weights of cement, fine and coarse aggregates.

Factors Connected with Both Methods

Either method requires the separation of the aggregates from the paste, and the separation of the fine from the coarse aggregate. The division point between the fine and the coarse aggregate is usually indefinite. Some fine aggregate will be retained on the sieve used and some coarse aggregate will pass through it. The same condition may exist between the cement and the sand. Some sand will pass through the No. 100 sieve and some cement may be retained on it. Some of the material contained in the coarse aggregate may also pass through this sieve.

It has been found that when a batch of concrete is mixed in a revolving drum a grinding action may take place which so changes the gradation of the sand that an appreciable amount of it may be of such size that it passes the No. 100 sieve. This amount of sand passing the No. 100 sieve increases as the length of the mixing period increases. Some of the coarse aggregate may also be ground to pass this sieve, and some of it may be broken suffi-

TABLE NO. 1—VARIATIONS IN CONVERSIONS OF IMMERSED WEIGHTS TO AIR WEIGHTS DUE TO VARIATIONS IN SPECIFIC GRAVITIES

(Weight of total sample of concrete in air = 30.00 lb.)

Items	Weights immersed		Correct specific gravities		Conversion of immersed weights to air weights—— Assumed specific gravities No. 1		Assumed specific gravities No. 2		Variation of assumed specific gravities from actual values	
	Direct	Differences	Direct	Differences	Variation from correct values		Variation from correct values		No. 1	No. 2
	Pounds	Pounds	Pounds	Pounds	Pounds	Per cent	Pounds	Per cent	Per cent	Per cent
Total Sample	(17.42)	.....	.....	.....	.....	.....	.....	.....	.....	.....
Coarse Aggregate	9.13	.....	14.63	.....	14.80	+ 1.16	14.98	+ 2.39	—1.88	—3.76
Fine Aggregate	5.87	.....	9.34	.....	9.44	+ 1.07	9.56	+ 2.35	—1.86	—3.72
Cement	.....	2.42	3.53	.....	3.56	+ 0.85	3.59	+ 1.70	—1.58	—3.15
Water	.....	.....	.....	2.50	2.20	—12.00	1.87	—25.20	.....	.....
Total	17.42		30.00		30.00	.....	30.00			

SPECIFIC GRAVITIES

	Actual values	Assumed values No. 1	Assumed values No. 2
Coarse Aggregate	2.66	2.61	2.56
Fine Aggregate	2.69	2.64	2.59
Cement	3.17	3.12	3.07

ciently to pass the No. 4 but not the No. 100 sieve. In order to approach accuracy in an analysis of this kind the following factors must be determined and applied in either method of analysis:

1. Initial percentage of fine aggregate passing the No. 100 sieve.
2. Initial percentage of fine aggregate retained on the No. 4 sieve.
3. Initial percentage of coarse aggregate passing the No. 100 sieve.
4. Initial percentage of coarse aggregate passing the No. 4 sieve and retained on the No. 100 sieve.
5. Percentage of cement passing the No. 100 sieve.
6. Percentage of fine aggregate ground up during the mixing action so that it passes the No. 100 sieve.
7. Percentage of coarse aggregates ground up during the mixing action so that it passes the No. 100 sieve.
8. Percentage of coarse aggregate broken during the mixing action so that it passes the No. 4 sieve but is retained on the No. 100 sieve.

The basis of proportioning on which the ingredients of the sample are computed must correspond with the basis of proportioning of the batch from which the sample is taken. For the aggregates it will be their weights in the bone-dry state or in the surface-dry state. This necessitates that with either method of analysis the maximum percentage of absorption of water for which the aggregates are capable and the total amount of water in the aggregates entering the batch must be determined in order to establish the basis of proportioning.

Selection of Method

The chief advantage of the first method is that the weights of three ingredients in the sample—cement, fine aggregate and coarse aggregate—are obtained directly; only one weight, that of the water, is obtained by differences in weights. A disadvantage of this method is that the cement must be reclaimed from the wash water. Considerable time is required for the cement to settle to the bottom of the "wash water" container so that the water can be decanted and the cement reclaimed. If the cement is to be weighed directly it must be dried. This also consumes time and requires a drying apparatus. If the weight of the cement is to be determined by the pycnometer method, its specific gravity must be determined. Another disadvantage of this method is that the aggregates must be dried. Drying apparatus is required if they are to be bone-dried. If they are to be surface-dried, errors may be introduced because of the difficulty in determining the surface-dry state, especially of the fine aggregate.

An advantage of the second method is that the cement does not have to be reclaimed from the wash water. The time, work, and equipment connected with this operation is eliminated. Another advantage is that no drying is necessary, thus eliminating the time, work and equipment connected with this operation. Converting the immersed weights of the aggregates and cement to their equivalent weights in air involves the use of the specific gravities of these three ingredients. This feature would result in inaccuracies in the analysis if the specific gravity values used were not the actual specific gravities of these ingredients as they exist in the concrete at the time the immersed weight of the sample is taken. The data in Table No. 1 is presented to show the manner in which variations in specific gravity values affect the results of the analysis. A slight discrepancy between the correct specific gravity and the specific gravity used in converting the immersed weight of the cement or aggregates to the corresponding air weight will have but a slight effect on the air weight of this ingredient. It may, however, have a considerable effect on the weight of the water; which weight is obtained by differences in air weights, and is only a small part of the total batch weight.

Both methods are subject to inaccuracies. The accuracy of the results obtained by either method depends on the accuracy with which each operation connected with the analysis is conducted. The first method involves more work and more equipment than the second method. The second method requires that the correct specific gravity values of the cement and aggregates be determined and used in the analysis.

(To be continued)

Coming Conventions

***June 25-29*—American Society for Testing Materials. Annual. Chalfonte-Haddon Hall, Atlantic City, N. J.**

***July*—The National Terrazzo and Mosaic Association. 1934 Convention. Toronto. J. M. Fuhrman, Secretary and Treasurer, 524 Brook St., Louisville, Ky.**

***December 6-7*—Highway Research Board, National Research Council. Fourteenth Annual Meeting. Roy W. Crum, Director, 2100 Constitution Avenue, Washington, D. C.**

Concrete and Creosoted Wood Piles Compared

Concrete Piles Only Dependable Type in Alternate Wet and Dry Locations—Their Greater Load-Carrying Capacity Offsets Difference in Cost

For locations exposed to alternate wet and dry conditions, concrete piles alone can be regarded as dependable. Upper picture shows handling of 60-ft., 24-in. square piles on bridge trestle of Missouri Pacific Railway near Watson, Ark. Lower picture shows portion of this 2,300-ft. timber pile trestle being replaced with concrete pile and cap construction

UNTREATED wooden piles are still barred from permanent construction where they will be subject to alternate wetting and drying, but creosoted piles are being actively promoted for underground use regardless of moisture conditions. The lumber interests and those whose business is the treatment of lumber have obtained and disseminated statements from some railroad bridge and building engineers to the effect that creosoted piles underground constitute permanent construction regardless of the ground water level. These statements are, of course, limited to foundations, but the proponents of creosoted timber endeavor to stretch them to include piles used partly above ground. In other words, creosoted wood piles are being actively promoted for use in a field in which concrete piles are generally conceded as being necessary for permanent construction.

There is insufficient evidence that creosoted piles are permanent where they are not continuously wet.

Allowance for Greater Load-Carrying Capacity

The argument that creosoted piles are durable under all conditions often makes the supposed difference in cost of creosoted wood and reinforced concrete a deciding factor. In one recent instance a very large contract was awarded for an installation of concrete piles on the basis of no additional cost over creosoted wood piles. This resulted from giving credit to concrete piles for their greater load carrying capacity.

A comparison of load capacity of piles may be set up as follows:

(1) The bearing power of a pile is equal to the skin friction plus direct bearing on the soil.
(2) In most soils the intensity of skin friction on driven piles is related to the size of the pile. Large piles compress the surrounding earth more than small ones and develop greater skin friction.
(3) The direct bearing on the soil is greater per unit of bearing area for large piles than for small ones.

The load-carrying capacity of a pile may be expressed by:

$$P = Af + pb \quad \ldots \quad (1)$$

in which

A = Area in contact with the earth less area of the section in direct bearing.
f = Unit frictional resistance on A.
p = Unit direct bearing power of the soil.
b = Area of pile in direct bearing on the soil.

The adhesion of earth to some substances is greater than to others. Creosote treatment of piles may reduce the skin friction.

Comparative tests on the skin friction on concrete and creosoted piles, while not as comprehensive as desirable, indicate a higher coefficient for the concrete than for the creosoted wood. In many soils this will amount to more than 20 per cent.

In Formula (1), A and b are easily computed from the dimensions of the piles. The direct bearing value p may be taken as equal for both wood and concrete. This favors the smaller pile. The coefficient f depends upon the nature of the soil penetrated, the surface material of the pile, and the consolidation or compaction of the soil. It should be greater for concrete piles than for smaller wooden ones. For purposes of comparison with creosoted wooden piles, Formula (2) is used to express the above reasoning.

$$f = 1.2 \left(1 + 0.3 \frac{C - W}{W}\right) f' \quad \ldots \quad (2)$$

where:

f' is the friction coefficient on creosoted wood.
C is the cross-sectional area of the concrete pile, and
W = the cross-sectional area of the wood pile.

The expression, $\left(1 + 0.3 \frac{C - W}{W}\right) f'$ is based on the assumption that an increase in cross-sectional area of 100 per cent will increase, through earth consolidation, the skin friction by 30 per cent.

The table, computed from Formulas (1) and (2), shows the relative load capacity of a 12-in. average diameter creosoted wooden pile and square concrete piles of various dimensions, taking the wood pile as unity.

From the table it is seen that the load capacity derived from skin friction increases much more rapidly than the size of the pile. Thus, a 16-in. square pile has 2.4 times as much capacity from skin friction as the wooden pile if the friction coefficient is the same, and 2.87 times as much if the coefficient is taken 20 per cent greater.

When concrete piles are manufactured in gang molds with internal vibrators, the cost per foot may not differ greatly from that of creosoted wood piles. A large railroad company recently manufactured thousands of concrete piles at a cost of approximately 80 cents per ft. This

compares favorably with the cost of large size creosoted piles in many locations. When estimates are made on the cost per ton carried, there are few, if any, conditions under which concrete piles can not compete on a first cost basis with creosoted wooden piles.

COMPARISON OF LOAD CAPACITY OF SQUARE CONCRETE PILES WITH 12-IN. AVERAGE DIAMETER CREOSOTED WOOD PILES (10-IN. POINT)

Assume same penetration for all piles, and that the superficial area per foot and skin friction coefficient for the creosoted wood pile is unity. Then the bearing power of the wood pile is expressed by $P = 1 + 0.78b$.

Size of Concrete Pile, in Inches	Relative Bearing Power (Wood Pile = 1 + 0.78b)	
	Same Skin Friction	20% Greater Skin Friction
12 x 12	1.25 + b	1.5 + b
14 x 14	1.82 + 1.36b	2.18 + 1.36b
16 x 16	2.4 + 1.78b	2.87 + 1.78b
18 x 18	3.00 + 2.25b	3.58 + 2.25b
20 x 20	3.73 + 2.78b	4.48 + 2.78b
22 x 22	4.64 + 3.35b	5.57 + 3.35b
24 x 24	5.68 + 4b	6.82 + 4b

A. S. T. M. Sessions on Cement and Concrete

Annual Meeting in Atlantic City at Chalfonte-Haddon Hall from June 25 to 29

A NUMBER of reports and papers of paramount interest to the concrete construction industry will be presented during the afternoon and evening sessions of June 29, at the thirty-seventh annual meeting of the American Society for Testing Materials. The meeting is to be held at Chalfonte-Haddon Hall, Atlantic City, N. J., from June 25 to 29, inclusive.

The Convention Program in Part

While some alterations may be made in the program heretofore announced, the following subjects pertaining to cement or concrete are expected to be covered by the speakers indicated.

Report of Committee C-1 on Cement. P. H. Bates, Chairman.

Contains pertinent discussion of suggested modifications of the standard of portland cement proposed in response to demands for various types of hydraulic cements, such as the low heat of hardening, and sulfate-resisting cements, for different types of construction. Report on co-operative series of sub-sieve fineness tests presents interesting data on particle size and specific surface of number of cements. Presents valuable report of plastic mortar tests on twelve cements by ten laboratories and recommends new tentative method of test for compressive strength of portland-cement mortars.

Study of Cement Composition in Relation to Strength, Volume Change, Resistance to Sulfate Waters, and to Freezing and Thawing of Mortars and Concrete. H. F. Gonnerman, Portland Cement Association.

Presents data on more than 130 cement compositions in relation to strength, volume change, resistance to sulfate waters and to freezing and thawing, of mortars and concretes. This paper is the outgrowth of 3 years' study based on laboratory-prepared portland cements covering a wide range of controlled compositions.

The Suspension Turbidimeter for Determination of Specific Surface of Granular Materials. Alexander Klein, University of California.

Discusses the rapid determination of specific surface of cement and other granular materials by a turbidimeter. Describes the apparatus and presents the principles and equations involved, together with the assumptions made in developing such equations. There is also included a statement of the procedure used together with results obtained with various portland cements as compared with results obtained on samples of the same materials with apparatus employing sedimentation principles.

The Vane Calorimeter. R. W. Carlson, University of California.

Describes a type of calorimeter which can be used for measuring heat of hydration of neat cement pastes while curing at substantially constant temperatures. This calorimeter has certain advantages over other types of calorimeters, chief among which are its low cost and its suitability for cements which are not readily soluble in acids. Presents typical data for a number of cements. Compares results from this calorimeter with those from the heat-of-solution calorimeter to indicate the approximate accuracy.

Report of Committee C-9 on Concrete and Concrete Aggregates. R. W. Crum, Chairman.

Presents new tentative specifications for sodium silicate for curing concrete and method of test for determination of coal and lignite in sand. Recommends adoption as standard of five existing tentative specifications for curing portland-cement concrete slabs. Contains abstract of unpublished paper by C. L. Ford on "Comparison of Standards for Colorimetric Test for Sand."

Paper appended: "A Study of the Permeability of a Few Integrally Waterproofed Concretes," by W. M. Dunagan and G. C. Ernst.

Effect of Duration of Moist Curing on the Principal Properties of Concrete. A. G. Timms, Portland Cement Association.

Presents the results of freezing-and-thawing, volume change, strength, permeability tests, and absorption of specimens cured various periods in the moist room before test. The study includes normal portland and high-early-strength cements, each cement being used with three different mixes.

Plastic Flow of Concrete Under Sustained Loads. R. E. Davis, H. E. Davis and J. S. Hamilton, University of California.

Describes results of laboratory tests made to determine the effect of plastic flow and shrinkage on the stresses in reinforced-concrete columns, the plastic flow of concrete subjected to bi-axial and tri-axial loading, and the effect of size of test specimen and temperature of storage upon flow. Presents additional data upon tests previously reported, in which some of the specimens have been loaded continuously over a period of about 7 years, showing the influence upon flow of intensity of sustained stress, moisture conditions, age at time of application of load, kind of aggregate, richness of mix and presence of reinforcing steel.

Proposed Method of Making Compression Tests on Portions of Concrete Beams from Flexure Tests. L. H. Koenitzer, Kansas State College of Agriculture and Applied Science.

Discusses a proposed method for making compression tests on portions of the specimens that were used for flexure tests. The method gives practically the same results as the standard 6 × 12-in. cylinders and as satisfactory results as prepared prisms commonly used on jobs where flexure specimens are tested. Presents the results of several hundred tests made on 6 × 12-in. cylinders, 6 × 6 × 12-in. prisms, and 6-in. modified cubes for various paving mixes. By this method any laboratory having a 300,000-lb. compression machine available can make compression tests on previously broken flexure specimens.

Report of Committee C-13 on Concrete Pipe. A. E. Phillips, Chairman.

Presents revisions of the standard specifications for non-reinforced concrete sewer pipe providing changes in details of test methods and elimination of requirements for all pipe sizes over 24-in. internal diameter, the larger sizes to be covered in the reinforced-concrete sewer pipe schedule. Recommends revisions of the tentative specifications for reinforced-concrete pipe involving changes in test specimens and test procedure, and material increases in the strength requirements for all sizes of pipe.

TIME —the unseen Ingredient

While concrete hardens, traffic is detoured, merchants lose sales —How 24-Hour Cement prevents these losses

NO LOST SALES HERE. Canal Street, New Orleans, commercial hub of the far South, had to be repaved. Merchants demanded quick action so 'Incor' 24-Hour Cement was used. Eighteen blocks were paved, a section at a time. New concrete, placed one day, was in use the next. Traffic was not diverted, business was unaffected. Merchants estimate this saved $5,000,000 sales loss.

Concrete poured today, ready for traffic tomorrow

Concrete's unseen ingredient is Time—the time consumed in hardening—once 28 days, then 14, now 10. But even ten days is much too long when you consider what this delay means. When traffic is diverted, business withers, merchants lose sales that never return. Motorists travel needless extra miles over dusty detours.

Now this problem is solved by a cement called 'Incor' which hardens *seven times as fast* as ordinary Portland cement. With 'Incor' 24-Hour Cement, the mixer pours concrete today—tomorrow you drive over it. In concrete buildings, column forms are stripped first morning after concreting, floor forms that afternoon; one form-set does the work of several, reducing form and handling costs; financing expense reduced, revenue from investment begins sooner. Result, a new era in concrete construction.

And 'Incor' makes better concrete because it is a perfected Portland cement. Its price is now little more than ordinary cement—a fraction of resulting economies. 'Incor'* is made by the producers of Lone Star Cement—subsidiaries of International Cement Corporation, New York, and is sold by other leading cement manufacturers.

* Reg. U. S. Pat. Off.

'INCOR' 24-Hour Cement

Comparative Tests of Premoulded Expansion Joint Material

Indiana Highway Commission Reports Comparative Performance of Sponge Rubber, Cork, Bituminous Rubber, and Bituminous Material

IN an unpublished report dated February, 1934, the Bureau of Materials and Tests of the Indiana State Highway Commission discloses the results of comparative tests of four different types of expansion joint filler, intended principally for use in concrete pavements and structures, according to the March issue of *Highway Research Abstracts*.

Several properties of the materials were studied, including the property of recovery upon release from a compressive load, brittleness, distortion, resistance to weathering and deformation when compressed. No less than 170 specimens of the materials shown in the table were tested.

TYPES OF EXPANSION JOINT MATERIAL TESTED

Type	Manufacturer	Thickness (Inches)
Sponge rubber	A	½, ¾, and 1
	B	½
	C	½
Bituminous rubber	B	½
	D	½, 1, and 1 3/16
Bituminous material	A	½, ¾, and 1
	B	½
	C	½
	D	⅜, ½, and 1
Cork	E	¾

The sponge rubber contained many voids, or air pockets. The bituminous rubber consisted of particles of ground rubber in a bituminous binder. The bituminous type is a mixture of felt or other fibre, bituminous material and filler. The cork was composed of particles of ground cork bound with a colorless synthetic resin, the surface having been coated with a bituminous material after molding.

Testing Methods

Rectangular specimens, 3 by 6 in., were cut for the tests. The specimen was compressed between two steel plates in a universal testing machine. Cork specimens were compressed to 80, 60, 50, 40, and 30 per cent of original thickness; sponge rubber to 80, 60, 50, and 40 per cent; bituminous rubber to 90, 80, 70, and 60 per cent; bituminous material to 90, 80, and 70 per cent. A sample was compressed to the desired percentage five times, with a period of one hour between compressions to allow recovery. For each compression, the load was recorded and immediately released. Recovery in thickness was measured after the fifth cycle, the sample was again compressed and held by bolts at the required thickness for seven days, then allowed to recover for 24 hours and the amount of recovery was then measured. While the sample was under the fifth application of load, the deformed dimensions were measured at right angles to the direction of compression and the extruded area was computed.

Specimens were subjected to 110 cycles of freezing and thawing to measure resistance to weathering. While freezing, the 3 by 6-in. specimens were set on edge in 1½ in. of water.

Brittleness and distortion tests were made on 2 by 6-in. specimens as described in U. S. Department of Agriculture Bulletin No. 1216. Absorption and specific gravity were determined.

Results of Tests

Based on ability to recover after compression, the fillers rated as follows: sponge rubber, cork, bituminous rubber, and bituminous material. The recovery of sponge rubber and cork and the low unit loads required for compression distinguish them from the other materials. The bituminous material showed small tendency to recover after once compressed momentarily and practically no recovery after compression was maintained seven days. When compressed to less than 50 per cent of the original thickness, the resistance of all the materials increases rapidly. With the exception of sponge rubber, the ability to recover is reduced by repetitions of load. For all materials tested, recovery is much less after prolonged compression than after momentary compression.

Cork showed least extrusion under compression, then sponge rubber, bituminous rubber, and bituminous material. Extrusion of the cork and sponge rubber was distinctly less than for the two bituminous types.

The covering of tar paper or felt did not affect the relation between load, degree of compression, and recovery. In general the behavior of the materials was independent of the original thickness. None of the specimens showed deterioration after 110 cycles of freezing and thawing. All passed the brittleness test except cork.

Much Concrete Work on Huge Earth-Fill Dam

WORK is under way on the gigantic PWA project southeast of Glasgow, Montana, where the Fort Peck Dam, at a cost of $72,000,000, will be built to control the flow of the Missouri River and create a reservoir 175 miles long. While this will be the largest earth-fill dam in existence, an enormous amount of concrete work will be required in the spillway and the auxiliary buildings and structures.

Total length of the dam, including wings on both sides of the main fill, will be nearly four miles. Flood control is the primary purpose, although the other advantages of this development will be found in navigation, irrigation and hydro-electric power. Between 600 and 700 men are at work clearing the reservoir site of timber, grading for the spur line, erecting buildings and setting up a temporary power line from Glasgow to the dam site. An allotment of $25,000,000 out of the total $60,000,000 has been made to cover the first year's work.

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EXPANSION JOINTS

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SERVICISED Bridge Planking has now been in use for more than seven years! No SERVICISED Planking has ever been replaced where it was recommended for the job. It is made in Standard, Sementread and Rock Surfaced styles and is in use on the main Chicago bridges where probably more traffic is encountered than on any other thoroughfare.

Western Avenue Bridge, Chicago, Illinois

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CORK
FELT SIDED
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COMPOSITION

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SERVICISED Expansion Joints, whether sponge rubber cork, felt sided, or plain composition, excel! SERVICISED Expansion Joints have given service over a period of twelve years, and are found in State highway work in every State in the Union which has used Expanion Joint within this period. You will not be doing justice to your organization without securing prices and learning about these products.

ASPHALT PLANKING

STANDARD—SEMENTREAD—ROCK SURFACED

SEMENTREAD is a new skid-proof planking—one which can be **guaranteed skid-proof**—when laid horizontal to the traffic it promptly stops the forward motion of the car, and when laid vertical to the traffic it stops the side skid as well as forward skidding. SEMENTREAD comprises a cement rib keyed in the asphalt plank surface, which adds rigidly to the surface also making it skid-proof. This material is especially adapted on city bridges and viaducts where wet days are a menace to traffic and where short skids are dangerous and cause accidents.

Be sure to learn about this product before laying another foot of planking!

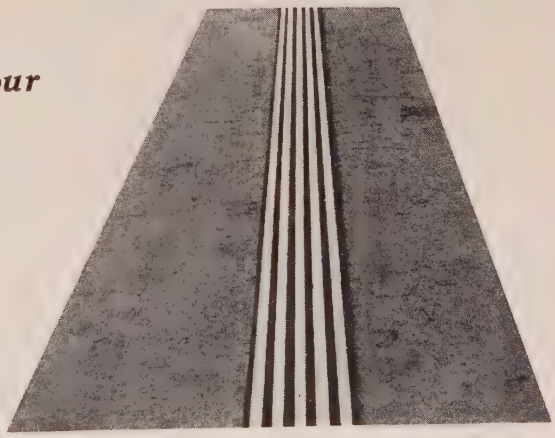
ROCK SURFACED PLANKING

ROCK SURFACED planking comprises SERVICISED asphalt planking having imbedded in its surface particles of rock. We do not believe that this is in any measure as skid-proof as SEMENTREAD. It, however, prevents skidding to a greater extent than the plain surfaced asphalt planking.

Skid-Proof Your Bridges

CENTER ROAD MARKINGS

SEMENTREAD planking in six or eight inch widths is highly adapted for road marking purposes having alternate black and white or black and yellow lines—the lines consisting of Portland cement.



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HOW TO DO IT

• Questions and Answers •
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Crushed Onyx and Pearl Shells

I am looking for some aggregate that has more life than crushed marble, to be employed in cast stone work and in a monolithic concrete store front. Can you refer me to a company that supplies this material?

Another special aggregate that we could use to good advantage is crushed pearl shells (a by-product in the manufacture of pearl buttons). Some years ago we used this aggregate in the manufacture of cast stone as well as in terrazzo work, both job-placed and precast. The company from which we obtained the shells is no longer in business, and we would be glad to have you place us in touch with other sources of supply.—R. R. C., Quebec, P. Q., Canada.

A list of a few producers of crushed onyx is being forwarded to you. Several names of producers of crushed pearl shells are also included. These shells, as you suggest, are by-products in the manufacture of buttons.

Matching Natural Stone

Can you give me a reliable set of directions for proportions and quantity of mineral colors for matching various natural stones, particularly sandstones, limestones and granites? This, of course, is in connection with the operation of a cast stone plant.—E. X. K., Albany, N. Y.

To match a natural stone effect in cast stone, it is necessary in most cases to use aggregates (both fine and coarse) of crushed stone of the kind to be matched.

Concerning the proportions to be employed in the mixtures, the proportions given below are recommended in H. L. Childe's book on *Manufacture and Uses of Concrete Products and Cast Stone*. In all cases the quantity of mineral color is expressed as a percentage of the cement, by weight. Thus, since a sack of cement weighs approximately 100 lb., the addition of 8 per cent of mineral color means 8 lb. of the coloring material for every sack of cement in the mixture. The recommended proportions follow:

Red Sandstone (first formula): Three parts of crushed red sandstone to one part of ordinary portland cement, plus 10 per cent of red oxide.

Red Sandstone (second formula): Three parts of crushed red sandstone of ⅛-in. size and smaller, to one part of a 50-50 mixture of white and ordinary portland cement, plus 5 per cent of red oxide.

Yellow Sandstone (first formula): Three parts of crushed yellow sandstone to one part of white portland cement, plus one per cent of yellow ochre.

Yellow Sandstone (second formula): Three parts of crushed yellow sandstone to one part of ordinary portland cement, plus 3 per cent of brown ochre.

Grey Limestone: Three parts of crushed grey limestone to one part of a 50-50 mixture of white and ordinary portland cement.

Yellow Limestone: Three parts of crushed yellow limestone of ⅛-in. size and smaller, to one part of white portland cement, plus 2 per cent of yellow ochre.

These proportions should be regarded primarily as starting points for experimenting. Actual trial mixtures may disclose the need for some changes in the proportions here given. The book to which reference is made can be obtained from the Book Department of CONCRETE.

Concrete Wall to Shut Off Tree Roots

Many flower and vegetable gardens on city lots yield unsatisfactory results because roots of near-by trees rob the soil of its fertility. A reader of *The Flower Grower* asked Madison Cooper, editor of that magazine, for a cure for such a situation without destroying the trees.

The solution recommended by Mr. Cooper consists in digging a narrow trench along or around the garden, on the side or sides toward the trees, and filling the trench with concrete. The concrete, of course, should be reinforced, by placing steel rods near the bottom and near the top, so as to prevent the formation of cracks large enough to permit entry of roots.

The required depth of the trench will vary with the character of the soil; but it is believed that 30 in. to 3 ft. will be ample. The depth within which these feeder roots are encountered, when digging the trench, will give some indication as to the necessary depth. Usually the greater part of the roots are not far below the surface.

Concrete Tennis Court Details and Specifications

As a part of a general contract we are to construct several concrete tennis courts here. We shall be greatly obliged if you can refer us to a source of plans and specifications for such courts.—E. C. T. Chittagong, India.

Complete plans and cross-section details, together with complete specifications, are given in an illustrated article appearing on pages 51-53 of the July (1930) issue of CONCRETE.

A multigraph giving similar information, and suitable for the use of engineers, architects and contractors, may be obtained on request from the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill.

Design of Rigid-Frame Structures

Can you refer me to books on the design of rigid-frame reinforced concrete structures, including bridges and buildings?—C. D. O., Cienfuegos, Cuba.

A list of such books is being forwarded to you. Reviews of several books of this character will be found in past issues of the magazine CONCRETE, particularly in the issues of January, 1934, page 19; October, 1933, page 18; January, 1933, page 23; and September, 1931, page 38.

• TIME SAVED

is MONEY GAINED

A CLOSED highway is as useless as an untilled field. However, as soon as it is opened its benefits to the public are inestimable. Early opening, made possible by Calcium Chloride curing, shortens the period of bumpy detours—reduces annoyance and travel cost to the public; also saves money for the contractor on detour maintenance—which is reflected in lower bids to the State, County or Municipality.

Considerations like these have already led more than half of our State Highway Departments to specify or permit the use of Calcium Chloride in the curing of concrete pavements. And by every known check-up and test, in thousands of instances, such pavements have proved themselves the equal, and in many respects the superior, of pavements cured by any other method. The testing engineer of the Connecticut State Highway Department states:

"Until the beginning of 1927 our roads were not opened to traffic according to the strength of the concrete, but were arbitrarily closed for a period of twenty-one days to afford time for proper curing. However, it was learned that pavements could be properly cured and safely opened to traffic in a much shorter period of time when Calcium Chloride was incorporated in the concrete mix for curing. Calcium Chloride incorporated in the concrete mix has been used for curing practically all of our road concrete construction since 1927; and as a result it has been possible to open the pavement in much less than the period previously specified before opening. In some cases pavements have been opened to traffic in as short a time as three days."

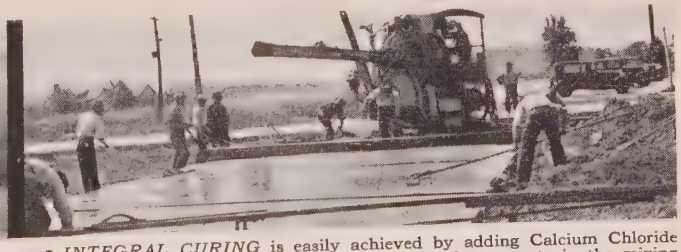
(The Engineering Department of the District of Columbia recently reported that pavements which were cured with Calcium Chloride were opened to heavy traffic in thirty hours, and in special cases as early as nine hours.)

Fifty per cent higher strength in 24 hours, and thirty per cent in 48, is definitely possible with Calcium Chloride curing. Furthermore, it is the only method that assures continued hydration and further hardening of the cement after the pavement is thrown open to traffic.

Calcium Chloride curing also eliminates laborious earth or straw covering and removal; expensive piping and pumping for water supply. It assures even curing—every slab is uniformly hard, durable, and virtually crack-proof. . . . It is the *modern* method—the reflection of modern thinking and wide-awake action on the part of highway officials and engineers. Explanatory literature, containing irrefutable facts—research, statistics, experience—will gladly be sent you on request. Address any of the following members of the CALCIUM CHLORIDE ASSOCIATION:

THE DOW CHEMICAL COMPANY . . Midland, Michigan
SOLVAY SALES CORPORATION . 61 Broadway, New York
THE COLUMBIA ALKALI CORPORATION, Barberton, Ohio
MICHIGAN ALKALI COMPANY, 10 E. 40th St., New York

• *SURFACE CURING* with Calcium Chloride is very simple. With an inexpensive spreader, one man can cover in two hours all the concrete the paver can lay in a day. No further wetting or other attention is required.



• *INTEGRAL CURING* is easily achieved by adding Calcium Chloride to the mixing water and incorporating it in the concrete in the mixing drum. Calcium Chloride accelerates the set—provides high early strength.

CALCIUM CHLORIDE

FOR MODERN CONCRETE CURING

Please say, "I saw it in Concrete"

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portable two hand
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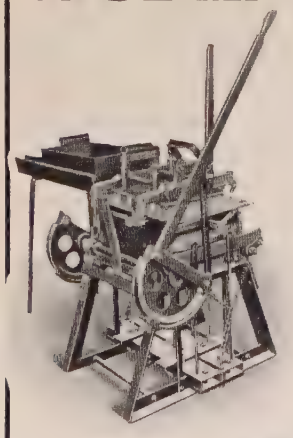

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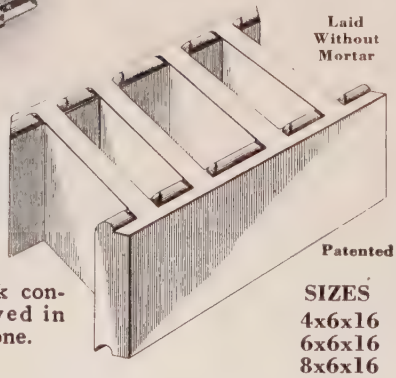

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Structural Drawing on Request

Mortarless Tile Machine Co., Inc.
22 Carrillo Bldg. Santa Barbara, Cal.

Many Monolithic Concrete Sewers Built by CWA

Should Play Important Part in Future Construction Organizations of This Type

MONOLITHIC concrete sewer work was not too difficult for crews of CWA workers, as this illustration shows. This project was a branch sewer of reinforced concrete, built through Forest Park, in St. Louis, Mo., to connect with the Des Peres, the "buried" river.

Construction work of this character, having permanent value, will probably constitute a considerable portion of the activities of future organizations such as the CWA. Aside from the project here illustrated, numerous monolithic concrete sewer jobs were carried to successful completion all over the country by CWA workers.

This monolithic concrete sewer in St. Louis was not too difficult for this CWA construction crew

Hollow Back-Up Units Approved for U. S. Post Offices

THE much-discussed question of permitting hollow unit back-up construction for U. S. Post Office buildings seems to be coming to a favorable conclusion.

Until very recently, the Procurement Division of the U. S. Treasury Department required solid back-up in exterior walls. Although hollow units were permitted for partitions, contractors were inclined to use the same material in partitions as in exterior back-up, so as to avoid the purchase and use of an additional kind of material. This placed hollow concrete units at a great disadvantage in the competition with clay brick.

The Procurement Division (formerly the office of the Supervising Architect) recently approved hollow-unit back-up for the plans and specifications of several post offices in the class ranging from $50,000 to $100,000. This action is believed to indicate a new policy in this respect, at least for the smaller post offices. Contracts for about 300 of this class may be awarded soon.

From the Patent Office

By J. KAPLAN
Patent Attorney, Washington, D. C.

Cement manufacturing process: Willoughby E. Snyder, Allentown, Penn. U. S. Pat. 1,948,433.—This method of manufacturing portland cement comprises the providing of raw material having a lime base, subjecting this material to a temperature such as will convert the lime base to an oxide, but insufficient to form silicates and aluminates of lime, subjecting the heat-treated material to hydration while the material is in the physical condition as the result of the heat treatment, dehydrating argillaceous material, mixing the dehydrated and the hydrated materials, clinkering the mixture, grinding the clinker to powdery form, and separating the carbonate particles which have not fully reacted to hydration prior to clinkering.

●

Machine for curing concrete: W. N. Stevenson, Attleboro, Mass. U. S. Pat. 1,946,819.—The machine consists of a carriage movable along the roadway, a package of sheet material mounted on the carriage, and mechanism supported on the bridge or carriage for delivering granular material from the carriage to the side edges of the sheet material as the carriage is moved along the roadway, to bond the side edges of the sheet material to the concrete and prevent displacement of the sheet material by wind during the concrete curing period.

●

Cement product and method of making: Howard R. Starke, Riverside, California. U. S. Pat. 1,947,504.—This cement product comprises a finely ground mixture containing materially in excess of 40 per cent by weight of material of a particle size between 10 and 30 microns, this mixture consisting principally of portland cement and also containing at least 5 per cent of an inert mineral material other than portland cement and between ½ and 1 per cent of oleaginous material, this inert mineral material and oleaginous material being interground with the portland cement.

●

Precast building units of porous concrete: Wallace L. Caldwell, Birmingham, Ala. U. S. Pat. 1,951,344.—This method consists of causing expansion, under atmospheric pressure, of a mixture comprising cement, water and an expanding agent, to take place in a mold sufficiently tight to permit the mixture under the internal pressure generated therein to exert its force against all internal surfaces of the mold, but not so tight as to prevent the escape of air, surplus gas, or excess water.

●

Method of curing concrete: Ira S. Reynolds, Kirkwood, Mo. U. S. Pat. 1,942,000.—The method of curing concrete consists of forming on the exposed surface of the wet unset concrete mass, as soon after tamping or finishing as might be practicable, a viscous, water-impervious, self-sealing, semi-fluid, protective coating of controlled volatility, formed from a volatile mineral oil solution of a compound composed of a saturated solution of naptha, rosin and pine oil with a suitable plasticizer.

●

Dewatering freshly placed concrete: G. M. Gordon, Los Angeles, Calif. U. S. Pat. 1,945,145.—The method covered by this patent consists of depositing a plastic concrete mass upon a prepared roadway base, covering a portion of the plastic mass with a chambered member, placing vibratory mechanisms in the contiguous mass, vibrating the mass to compact it and release excess water, exhausting the air from the chamber, and extracting a portion of the water from the mass.

●

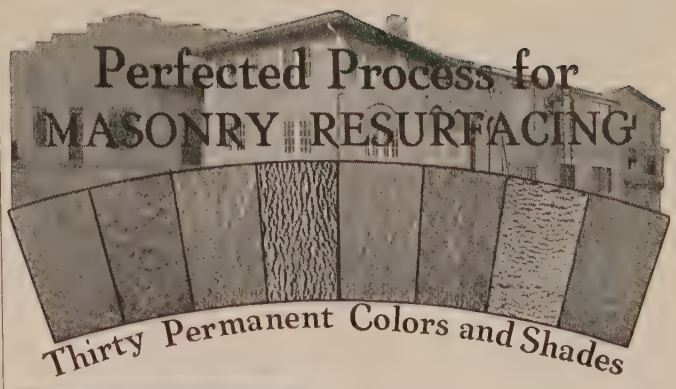
Japanning concrete surfaces: Sotojior Asobe, Japan. U. S. Pat. 1,944,588, January 23, 1934.—The process of japanning concrete surfaces consists in applying a ground layer of material comprising a mixture of raw japan, asphalt, jinoko, and tonoko, thereafter applying a second layer comprising a mixture of raw japan and jinoko, and finally applying a finishing layer of japan.

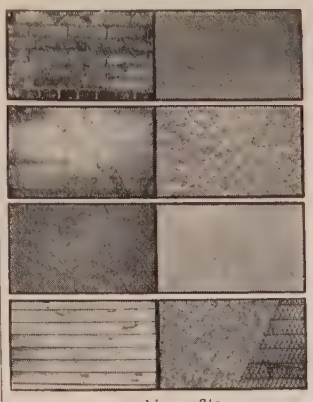
●

Waterproofer and bond for concrete: Raymond W. Bowman, Indianapolis, Ind. U. S. Pat. 1,950,444.—The composition consists of sal amnoniac, hydrated lime and substantially free comminuted grey iron, in such proportions as to form a waterproof bond with concrete.

●

New cement gun: John T. Vawter, Los Angeles, Calif. U. S. Pat. 1,941,726.—This mechanism consists of a solid egg-shaped obstruction near the mouth of the gun, to reduce the speed of the flow of concrete when leaving the gun nozzle.





Everyone interested in concrete or its construction will welcome this amazing process. Owners of masonry homes everywhere have been waiting for just such a method for the permanent renewing of walls and all masonry surfaces. Paint is unsatisfactory and too costly.

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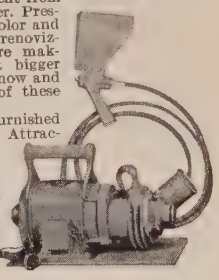

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New Books and Pamphlets

A. R. E. A. Report on Masonry

REPORT OF COMMITTEE VIII—MASONRY is the title of a 40-page illustrated report presented at the recent annual meeting of the American Railway Engineering Association, whose head office is at 59 East Van Buren Street, Chicago.

Sections of the report covering subject-matter of exceptional interest include details of reinforced concrete trestle design; design and construction of reinforced concrete arches; high-frequency vibration in the placement of concrete; centrally-mixed and transit-mixed concrete; specifications for lining tunnels with concrete; pneumatically projected concrete; and the design and details of expansion joints in concrete structures.

Portland Cement Concrete

GROWTH AND MOVEMENT IN PORTLAND CEMENT CONCRETE, by C. G. Lynam. Published by Oxford University Press, London and New York. Cloth, 139 pages, 5½ by 8½ in., 54 line drawings and diagrams. Price $3.50.

This volume is devoted entirely to the examination of the great mass of published results of research work in the field of cement and concrete. The various theories and experimental results are summarized. The subject-matter of individual chapters includes the hardening of portland cement, shrinkage and internal stress, bond, elasticity and creep, and ultimate strength and working stresses. The final chapter discusses unsettled points.

Grade Separation Structures

NEW DEVELOPMENTS IN GRADE SEPARATION STRUCTURES, by Charles P. Disney, bridge engineer, central region, Canadian National Railways, Toronto, Ontario, Canada, is the title of the principal paper in the April (1934) issue of the *Journal* of the Western Society of Engineers, Chicago.

The railway-highway structures described include the rigid frame type as well as the precast slab type, the latter being employed in cases where the interruption to traffic must be held at a minimum. One of the structures under discussion is described and illustrated in an article on pages 5 and 6 of the January (1934) issue of CONCRETE.

Helps to Successful Contracting

HELPS TO SUCCESSFUL CONTRACTING, by Harry O. Locher. Published by McGraw Hill Book Co., Inc., New York. Cloth, 222 pages, 5 by 7½ in. Price $2.00.

Here is a large collection of practical helps, suggestions and examples for the contractor who wishes to develop cooperation and efficiency in all parts of his organization. All phases of contracting work are covered. The ideas presented deal with important but frequently neglected items such as attention to detail and regard for human relations.

Influence Lines in Arch Design

INFLUENCE LINES FOR ARCHES is the title of a new publication issued as Bulletin No. 9 by the University of Minnesota, Minneapolis, Minnesota.

ORGANIZATIONS

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

AMERICAN CHEMICAL SOCIETY, Mills Building, Washington, D. C.

AMERCIAN CONCRETE INSTITUTE; Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich. Thirtieth annual convention, February 20-22, Royal York Hotel, Toronto, Canada.

AMERICAN CONCRETE PIPE ASSOCIATION; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Bellevue Court Bldg., Philadelphia, Pa.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; E. H. Fritch, Secretary, 59 East Van Buren St., Chicago, Ill.

AMERICAN ROAD BUILDERS' ASSOCIATION; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

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AMERICAN SOCIETY FOR TESTING MATERIALS; C. L. Warwick, Secretary-Treasurer, 260 S. Broad St., Philadelphia, Pa.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

BUILDING OFFICIALS CONFERENCE OF AMERICA; Wm. F. Hurd, Secretary, Room 203, City Hall, Indianapolis, Ind.

CAST STONE INSTITUTE; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

CEMENT INSTITUTE; H. C. Lundborg, General Manager, 11 East 44th St., New York City.

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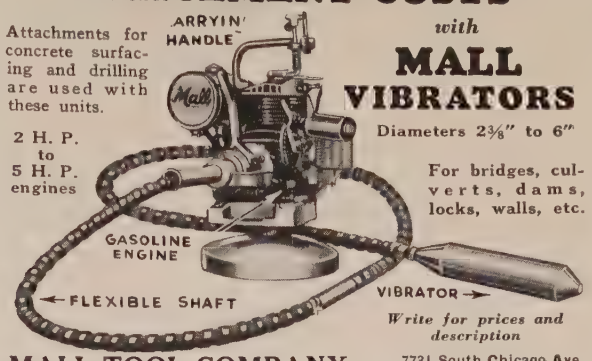

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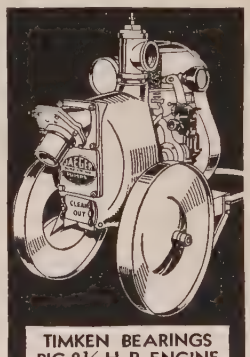

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EQUIPMENT AND MATERIALS

THE Mall portable gasoline engine vibrator, offered by the Mall Tool Company of Chicago, is adapted to the needs of contractors on large and small construction jobs where inspection is critical and where concrete is difficult to place.

Mall vibrators are of the internal type and are immersed directly into the concrete, sending the vibration waves out several feet in all directions. The makers say it is not necessary to have special form work as no violent vibratory action is placed on the forms.

Any depth and size of wall, dam, lock or bridge construction job, they say, can be vibrated with the Mall unit by adding suitable lengths of flexible shafting in units of 7 ft. These vibrators vary in size from 2⅜-in. to 6-in. diameters and are furnished with gasoline engines or electric motors which range from 2 hp. to 5 hp., depending on the size and type of form, the slump of concrete and the number of yards poured per hour. Ninety per cent of the gasoline engine power is delivered to the vibrator. The gas engines may be run at variable speeds to meet different specifications.

These gasoline engine and electrical power units may also be used for concrete rubbing or finishing, high speed grinding and drilling by adding the necessary attachments for each application.

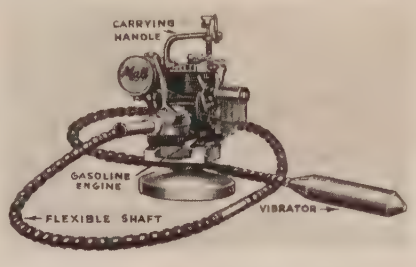
•

THE Rex Roadmaker for 1934 is described in Bulletin 244, being distributed by the Chain Belt Company of Milwaukee. The outstanding feature of the new 1934 Rex Modern Drum Paver, according to the makers, is its modern high carbon steel drum with replaceable alloy steel liners on each of its buckets and blades and in its charging head. Rubber sealing rings prevent leakage with low slump concrete. This drum runs on Timken bearings. Other outstanding features are the Rex mechanical man and the governor booster which work together, they say, to make for faster charge and discharge.

•

BESSER Mfg. Co., of Alpena, Michigan, announces a complete new line of automatic and power operated plain pallet stripper block machines. They say this improved line covers a range of capacities from the big production automatics down through several power operated models with capacities varying in proportion to the number of operations which are power driven.

JAEGER-LAKEWOOD, a new automatic finisher, offered by the Jaeger Machine Company of Columbus, Ohio, is said to be as flexible as steam and is adapted for concrete or bituminous road or street work. Higher speeds and velvet touch are claimed. Either gas-engine or gas-electric power is available.



Mall portable gasoline-engine vibrator

Industrial Literature

POTTSCO Light-Weight Aggregate, recommended by the Pottsco Corporation of Chicago for structural concrete, fireproofing, load-bearing building units, bridge decks, nailing concrete precast structural slabs, precast roof slabs, partition units, floor- and roof-fill, or wherever dead load saving is advantageous, is described in a new loose-leaf catalog. The booklet contains data intended to acquaint the reader with the qualities and advantages of Pottsco.

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JAEGER "Sure Prime" pumps are covered in Bulletin P-34, being distributed by the Jaeger Machine Co., of Columbus, Ohio. One of the models is a 4-in. bridge builder's or contractor's pump said to be ideal for caisson work, and such larger jobs as drainage, for bridge contractors, sea walls, excavations, sewers, and septic tanks.

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TRUSCON, for April, 1934, published by Truscon Steel Company, Youngstown, Ohio, and presenting the company's products in catalog fashion, is the first issue of a monthly publication devoted to the progress of building construction and the development of their products and ideas, directed to the building fraternity.

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COLOR Charm is the title of an attractive folder just issued by the Portland Cement Association, Chicago. Color in concrete makes charming improvements of garden walks, terraces, driveways, floors, pools, recreation rooms and landscape designs.

•

COLOR harmony and style trends for public buildings and homes are subjects of a recent piece of literature by the Ricketson Mineral Color Works of Milwaukee, Wisconsin. Colored concrete is being used in public buildings, churches, garages, homes, tennis courts, etc.

•

TERRAZZO specifications is a new booklet published by the Medusa Portland Cement Company of Cleveland. In addition to flooring, terrazzo is also used for bases, wainscoting, stairs, swimming pools, etc. Color illustrations show a few designs and color schemes.

•

HOW Dowflake Cures Concrete" is the title of a new folder being distributed by the Dow Chemical Company of Midland, Michigan.

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Manufacturers' News

THE Thompson & Lichtner Co., Inc., engineers of Boston, Mass., announces the removal of its offices to larger quarters at 620 Newbury Street. Edwin S. Parker has been added to the executive staff.

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Ralph P. Brown, a graduate engineer, formerly in charge of publicity for the National Lime Association and the Brown Instrument Company, has joined the advertising department of the Timken Roller Bearing Company and the Timken Steel and Tube Company.

•

Charles B. Foster, well-known executive of the Harnischfeger Corporation, has been appointed sales manager of the entire P&H line of full revolving excavators ranging from ⅜ to 4 cu. yd. capacity, trenchers, backfillers and pipe line equipment.

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Edmund Billings has been elected a vice-president of Godfrey L. Cabot, Inc., Boston, Mass., manufacturers of Charon, a black pigment for concrete.

Vol. XLII
No. 6

Cement Mill Section of
Concrete

JUNE
1934

Chalk and Portland Cement Clinker Produce White Cement

Successive Investigations Develop Cold Process—Chalk and Clinker Ground in Tube Mill—Industrial By-Product Also Suitable—Mineral Pigments Add Luster

By PETER P. BUDNIKOFF
Professor, Laboratory of Ceramics, Chemistry Technological Institute, Charkoff, U.S.S.R.

WHILE making investigations connected with the production of clinkerless slag cement* the author was faced with the annoying conditions peculiar to slag cement—the odor of hydrogen sulphide. When an experimental building was built, in the construction of which this type of cement had been utilized, the odor of hydrogen sulphide remained in it for a long time. Without awaiting the elimination of the odor by airing, orders were given to whitewash the building on the inside with chalk. This resulted in the complete disappearance of the odor of H_2S, a fact which led the writer to the idea of adding chalk in the process of producing clinkerless slag cement. This was accomplished by grinding basic granulated blast-furnace slag with suitable activators —for example, a mixture of anhydrite ($CaSO_4$) with dolomite burned at 900 deg. C. or with dolomite dust obtained as a by-product in the production of metallurgical dolomite.

In all cases where an addition of 2 to 3 per cent of chalk had been introduced, the finished product (clinkerless slag cement) had lost the odor of hydrogen sulphide to a considerable extent, and the compressive and tensile strengths of the cement had increased.

Applying Same Principles to Portland Cement

The facts just enumerated led the writer to make further investigations in the direction of adding chalk, dolomite and marl when grinding standard portland cement clinker. The results of his laboratory investigations in this new direction are shown in Table 1 and Table 2. In all cases the cement demonstrated a constancy of volume.

Tests Under Plant Conditions

The highly satisfactory results of the laboratory investigations encouraged the writer to undertake further investigations under plant conditions at three portland cement plants. At two of the plants, cement clinker was taken from rotary kilns. At the third plant the clinker was taken from a shaft kiln with rotating fire grates. The clinker was ground in a three-compartment mill, 10 per cent and 20 per cent of chalk having been added to the different charges. The chalk previously had been dried in a drying drum. Gypsum was not added, except that 2 per cent of gypsum was added to some of the clinker, to which no chalk had been added. This, of course, was done for the purpose of getting samples of standard portland cement for comparison with the chalk portland cement.

Excellence of Product Shown

Samples of cement and clinker were taken during the grinding operation and were tested at the plant laboratory. The results of these tests are given in Table 3, in which the symbol *M*1 denotes cement containing 10 per cent of chalk; *M*2 denotes cement containing 20 per cent of chalk; and *N* denotes the normal portland cement to which no chalk had been added, but which contained the usual 2 per cent of gypsum. Each of the three types of cement passed the test for constancy of volume.

Further tests (in addition to those summarized in Table 3) were conducted at our laboratory—the Laboratory for Ceramic Technology, Chemical Technological Institute, Charkoff. In general, results were consistent with those shown in Table 3.

Action of Chalk Explained

The data obtained indicate that the chalk portland cement made with clinker from the shaft kiln attained a higher tensile strength than was the case with portland cement without chalk. The crushing tests of the same cement showed a somewhat modified aspect, since in this case the portland cement without chalk had a higher compressive strength than the cement containing chalk.

The action that occurs when chalk is added to portland cement may be explained in the following way: The chalk acts as a densifying agent, and also as an absorbent. If the quantity of water is sufficient, the *sol* that is being formed under the influence of the hydration of cement coagulates under the influence of sensibilization to a *gel*,

*See article on "Producing Clinkerless Slag Cement," by Peter P. Budnikoff, in Cement Mill Edition of CONCRETE, March, 1934, pages 39-41.

TABLE 1—TENSILE STRENGTH, IN LB. PER SQ. IN., WITH STANDARD 1:3 PORTLAND CEMENT-SAND MORTAR

Material added	Per cent added	Age at time of test: 4 days	7 days	28 days	2 months
Chalk	1	280	306	344	442
	2	302	326	337	470
	5	289	289	337	411
	10	263	295	333	438
	30	245	260	297	413
Dolomite	1	338	321	415	445
	2	306	348	455	437
	5	314	353	438	427
	10	353	328	384	398
	30	262	260	341	401
Marl	1	253	252	373	393
	2	312	356	413	423
	5	272	273	395	451
	10	289	295	434	468
	30	265	265	373	374
Tensile strength of 1:3 mortar of same portland cement without additions		262	313	407	417

Fineness of slag cement: Retained on 4,900-mesh sieve (178 meshes per lin. in.), 15.2 per cent. Retained on 900-mesh sieve (76 meshes per lin. in.), 0.4 per cent.

TABLE 2—COMPRESSIVE STRENGTH, IN LB. PER SQ. IN., WITH STANDARD 1:3 PORTLAND CEMENT-SAND MORTAR

Material added	Per cent added	Age at time of test: 4 days	7 days	28 days	2 months
Chalk	1	2,390	3,810	3,690	3,400
	2	3,320	3,180	3,560	4,580
	5	2,700	3,660	3,430	4,800
	10	3,520	4,010	4,010	4,170
	30	3,350	3,790	4,320	3,770
Dolomite	1	2,740	2,920	3,800	3,060
	2	2,310	3,100	3,600	3,000
	5	2,180	2,630	2,700	2,730
	10	2,170	2,210	2,540	3,080
	30	1,540	2,140	2,180	2,830
Marl	1	1,480	1,970	1,890	2,440
	2	1,720	2,650	2,790	2,830
	5	2,010	1,970	2,680	2,830
	10	1,220	1,940	2,920	3,730
	30	1,560	1,880	2,440	2,660
Compressive strength of 1:3 mortar of same portland cement without additions		3,050	3,140	3,690	3,760

The cement was the same as that employed in making the tensile tests, reported in Table 1.

and the whole mass densifies. The particles of chalk imbedded in and distributed throughout the colloidal *gel* are being enwrapped by it. Instead of decreasing the strength of the cement, this condition has a tendency actually to increase the strength, when certain percentages of chalk have been added.

White Cement Produced by Cold Process

The next step in this sequence of investigations led naturally to an examination of the possibilities of obtaining white portland cement by the cold process—that is, by grinding portland cement clinker with 60 to 70 per cent of chalk.

The investigations conducted by the author in this direction demonstrated that portland cement with an addition of 60 to 70 per cent of chalk, when mixed with white sand in the proportion of 1:3 (or preferably 1:2), attains a high degree of whiteness, and quite sufficient physical strength, making it appropriate for use in plaster and stucco. The bond of the white chalk portland cement with normal portland cement is very firm. This was demonstrated by means of tensile tests of mortar briquettes. One half of the briquettes was made with normal portland cement, and the other half with chalk cement made of a mixture of 60 per cent chalk and 40 per cent portland cement clinker. Each kind of cement was mixed with sand in the proportion of 1:3. During the tensile tests many of the specimens broke in such a manner that the rupture took place, not on the dividing line between the two cements, but through the white cement.

A second method of obtaining white cement resulted from other investigations made by the writer. These investigations demonstrated that white cement can be obtained also by an intimate mixture of portland cement and pure kaolin, or better still, by the grinding of kaolin with portland cement clinker. Proportions may be 70 per cent kaolin and 30 per cent clinker.

The kaolin must be dried, or (preferably) burned at a temperature of 700 to 800 deg. C., at which temperature it attains puzzolanic properties. The cement thus obtained has a pleasing white color. When used in mortar, stucco or plaster, it should be mixed with white sand in the proportions of 1:2 or 1:3.

The chalk cement shows excellent resistance to water and to freezing. It clings well to brickwork and to concrete.

Mineral Pigments Add Luster

Mineral pigments introduced in portland cement to which 20 per cent of chalk had been added produced a bright, lustrous color. A good pigment for this purpose is the ferrous by-product obtained from the production of alpha naphthylamine. It is also permissible, in the production of this white cement composed of 60 to 70 per cent of chalk and 40 to 30 per cent of portland cement, to replace the chalk with the residue obtained from the production of aluminum chloride from kaolin where the method employed is that of treating with a mixture of $Cl_2 + CO$. The amount of this residue added is the same as with chalk—namely, from 60 to 70 per cent of the residue ground with 40 to 30 per cent of portland cement clinker.

TABLE 3 -RESULTS OF TESTS CONDUCTED UNDER PLANT CONDITIONS

Identity of cement	Composition of cement, expressed in percentages: Cement clinker	Chalk	Gypsum	Fineness of cement—Per cent retained on 76-mesh[1] sieve	on 178-mesh[2] sieve	Time of set: Initial	Final	Strength of 1:3 cement-sand specimens, in lb. per sq. in.: Tensile strength 4 days	7 days	28 days	Compressive strength 4 days	7 days	28 days
M1	90	10	....	3.0	21.0	1 hr. 15 min.	4 hr. 55 min.	188	228	256	2,390	2,500	3,340
M1	90	10	....	1.8	21.9	1 hr. 15 min.	7 hr. 35 min.	171	209	256	1,710	1,990	3,560
M2	80	20	....	1.0	17.0	1 hr. 05 min.	6 hr. 15 min.	164	185	275	1,690	2,130	3,330
N	98	....	2	5.0	27.2	1 hr. 55 min.	6 hr. 25 min.	209	192	245	2,020	2,820	3.700

[1] 900 meshes per sq. cm. [2] 4,900 meshes per sq. cm.

How Accident Hazards Are Controlled in Cement Mill Grinding

Study by National Safety Council Shows Where Hazards Exist —Choice of Protective Measures Based on Judgment and Experience

By W. D. KEEFER
Director, Industrial Safety Division, National Safety Council

THE seriousness of accident hazards in cement mill grinding is indicated by a comparatively recent report of the Portland Cement Association. This report is for the year 1930 and covers 128 plants. It shows that 18.9 per cent of the lost-time accidents of these plants, and 19.3 per cent of the time actually lost from such accidents, are chargeable against the raw and finished cement grinding departments.

National Safety Council's Contribution

Toward the control of this group of accident hazards, the National Safety Council has made a special study which has resulted in the publication of a new industrial safety pamphlet entitled "Raw and Finished Cement Mill Grinding." This is one of a series of six published pamphlets dealing with the control of accident hazards in the manufacture of portland cement. The new pamphlet was drafted by S. H. Harrison, assistant superintendent of the Vulcanite Portland Cement Company, of Phillipsburg, New Jersey, and Stewart J. Owen, Jr., safety engineer of the National Safety Council. It was worked out in cooperation with the cement section, the safe practices conference committee, and the executive committee of the National Safety Council. It is a compilation of experience in accident prevention, and contains many suugestions of value in the operating field which it represents.

Where Hazards Exist

The pamphlet considers the hazards from both the "dry" and the "wet" process in cement manufacture. There are important hazards in power transmission, especially in some of the older mills where a belt or rope drive from a line shaft, with or without friction or other type of clutch, is used. The pamphlet recommends, in such cases, that belts, pulleys and other moving parts should be enclosed to prevent accidental contact with them. When an electrical drive is employed the frame of the electrical apparatus should be properly grounded so as to prevent shocks to the attendant in case of electric trouble.

Caution should be taken to see that electric starters are adequately safeguarded so that the machinery can not be set in motion without the knowledge of the person assigned to that duty. A good rule rigidly enforced by some companies when machines are under repair is "open the switch and lock the switch box." No lock should be removed except by the person who placed it.

Where extension cords are used when it is necessary for somebody to enter tube mills, ball mills or mills of similar design, such cords should be well insulated and designed to withstand mechanical injuries and abuses. All extension cords should be carefully inspected at regular intervals for breaks, burnt spots, or other defects. To avoid the possibility of shock while using extension cords, some cement companies, by means of small portable transformers, step the voltage down to six volts and use automobile headlight bulbs instead of the regular 110-volt lamps.

It is advised, where the work requires it, that men

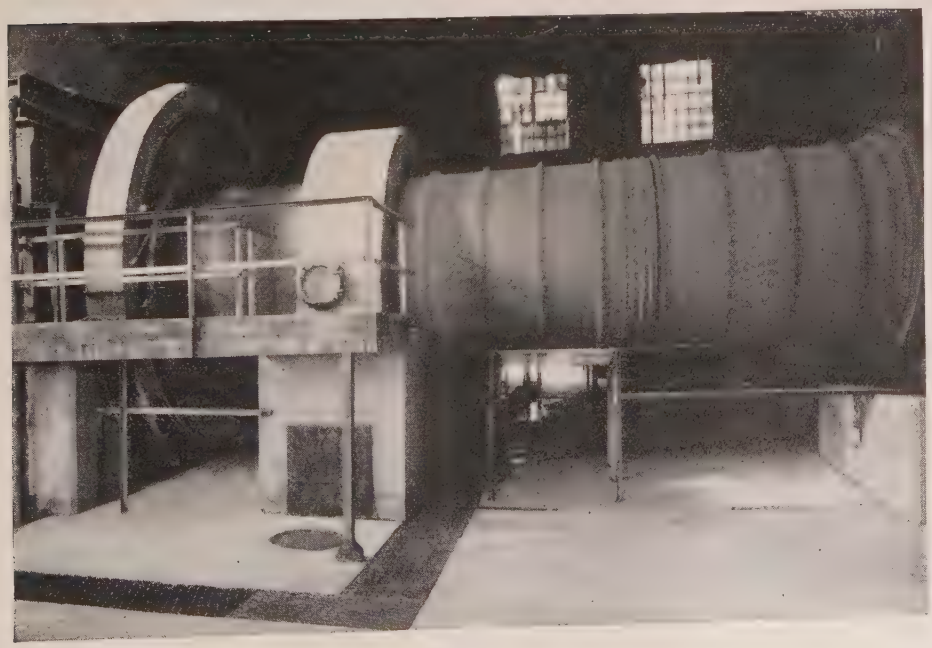


Figure 1. One of Bessemer's compartment mills. A railed platform at the feed end and a screened passageway under the mill protect workmen from accidental contact

Courtesy The Bessemer Limestone and Cement Co.

working in clinker, rock or shale bins poking down material, should work in pairs, one man on the inside and the other on the outside. The man inside should wear a safety belt with anchor rope attached, the free end of which should be held by the outside man. Other protective devices are chain ladders and alarm systems by which a man in the bin may signal to the tunnel man in case of an accident, and goggles to protect their eyes against flying material.

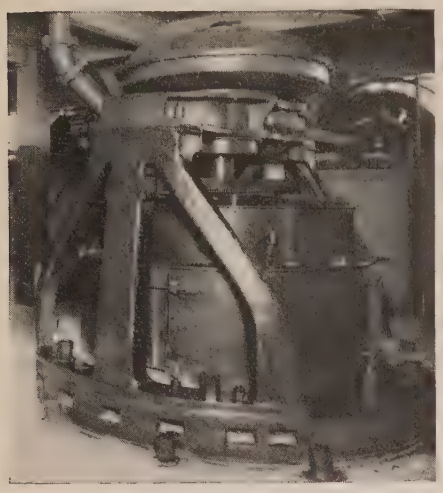


Figure 2. A well guarded preliminary finish grinding mill at one of International's plants

Courtesy International Cement Corp

All belts, pulleys, gears and other moving parts of machinery that may be a source of injury should be so enclosed as to prevent accidental contact with them. When it is necessary to dress a belt in motion it should be done by an experienced and cautious worker, who does not wear ragged or loose clothing and who should apply the dressing to the belt near the point where it leaves the pulley.

Sprocket wheels, chains, belts, gears and rollers on dryers should be enclosed in substantial metal boxes. Other hazards on dryers include oiling of revolving parts and the lighting of fuel burners.

The hazards from crushers relate to flywheels, belts and pulleys, hammer pins, hoppers, punching down material, and magnetic separators.

At Ball and Tube Mills

The hazards in ball, tube, compartment and roll mills are from contact with moving parts, the removal of manholes, the loading of tube mills, the plugging of tube mills, lack of proper guard rails around large motors, injurious effects from zinc fumes unless workers are provided with masks with a sufficient supply of fresh air, flying wedges used in the removal of doors of mills, and roll mill feeding devices which may get out of order.

The hazards from screw conveyors is especially severe. It is advised that never, under any conditions, should an attempt be made to loosen material in a screw conveyor or trough or to make any repairs without first shutting off the power and locking the motor switch, as well as hanging a danger sign reading "Man working on conveyor" on the starting switch.

Pneumatic conveyor systems are generally buried under ground, but there are hazards through possible contact with the couplings between the motors and the pumps, and injuries to the fingers when repairing or adjusting valves. These hazards require special precautions.

It is recommended that all bucket elevators, wherever located, should be closed so that contact with the buckets will be prevented. This will also prevent burns from hot clinker overflow. Sprocket wheels and chains, belts and pulleys driving these elevators should be inclosed with substantial guards.

Dust Collection a Safety Measure

Dust collectors are being used increasingly, because the dust gets into the gears, bearings and other parts of the machinery and the abrasive action increases the rate of wear and thus makes premature renewal of these parts necessary. The chief hazard from dust collectors is on parts that may be improperly guarded, including belts or direct connected couplings used for driving exhaust fans. The outlet or discharge openings of fans should be covered with screens of ¾-in. or 1-in. wire mesh to prevent injury to a person who may come in contact with the revolving fan blades, or material may be thrown or dropped into the fan housing and wreck the fan.

To prevent men falling into slurry tanks, walkways with double handrails and toe boards should be provided over the tanks. Also every effort should be made to keep the walkways free from a slippery condition.

Figure 3. One of the National Safety Council posters that serves as a constant reminder

In the operation of scales all moving parts which may injure anyone by accidental contact with them, should be enclosed or otherwise guarded in an effective manner.

Yosemite Surplus Growing

THE first dividend policy to be declared by the management in six years was enunciated by A. Emery Wishon, president of the Yosemite Portland Cement Company, of San Francisco, who said a division of profits will be declared as soon as the company's surplus has reached $225,000, one-tenth of Class A stock valuation.

Mr. Wishon pointed out that the surplus as of December 31, 1933, totaled $192,302, as compared to $187,633 at the end of 1929. Sales volume during January this year increased 91 per cent over sales during January, last year, he disclosed in his annual report.

American Institute of Chemical Engineers Holds Its Largest Meeting

More Than 25 Per Cent of Membership Register for New York Meeting, May 14 to 16—Papers on Fuels and Power Generation Predominate

THE American Institute of Chemical Engineers has the distinction of increasing in membership while many other technical societies are moving in the opposite direction. Also, it has just broken all attendance records for one of its semi-annual meetings. Two reasons are the growth in the profession of chemical engineering and the excellent programs the Institute always offers.

The programs are based on principles so fundamental in character that they are applicable to technology in general and are by no means restricted to the particular industries that happen to be represented in the papers and inspection trips. At this meeting portland cement was scarcely mentioned, but papers on fuel and power predominated—and what industry is more concerned with these matters than the cement industry?

Monday was devoted largely to petroleum. The technical session on applied chemical engineering included the following:

The Trend of Chemical Utilization in Petroleum Refining, by P. C. Keith, Jr., and H. O. Forrest.

Prospects of a Petroleum Chemical Industry, by Carleton Ellis.

In the afternoon there was an inspection trip to the Elizabethport plant of the Standard Oil Company of New Jersey. Here Institute members had the opportunity to inspect the extensive and well equipped buildings devoted to research, and to see hydrogenation equipment in operation. Oil is treated with hydrogen in large steel vessels, the walls of which are 7 in. thick. The hydrogen is compressed in four-stage compressors to 3,500 lb. per sq. in. Research is active in the chemistry of petroleum and the chemistry of coal. One receives the impression that petroleum technologists will not be content until they have made everything that can now be made with coal, and that coal technologists have corresponding objectives.

On Tuesday two technical sessions were held simultaneously. These were on applied chemical engineering, and principles of chemical engineering. The two programs appeared equally interesting. The writer attended the former, at which three papers were delivered:

Industrial Developments in Heat Transfer with Organic Compounds, by R. Lyman Heindel, Jr.

Mercury Vapor as Applied to Process Industries, by C. A. Hulsart.

The Stroboscope and High-Speed Motion Picture Camera as Research Instruments, by H. E. Edgerton and K. J. Germeshausen.

Wednesday's technical session was held at Rutgers University, New Brunswick, New Jersey. In the afternoon several industrial plants in the locality were visited.

When external combustion heat engines first came into use, water was used for the heat transfer medium. It was inexpensive, widely distributed, and there was more information available than for any other liquid. Water is still the principal medium and may always remain so, but it is no longer used exclusively for the purpose. Research has revealed that there are substances which possess some characteristics superior to water. Among these may be mentioned mercury, certain organic compounds, and some aqueous solutions. Papers have appeared in the literature from time to time, but at this meeting of the Institute there was a series of papers which brought out forcefully the importance of the matter and indicated the lines along which developments may proceed. Two of these have been mentioned. The third was "Solution Cycles," by W. H. Sellew.

How Formation of Clinker Rings May Be Prevented

Control of Silica Modulus and Use of Siliceous Powder Recommended

IN an article in *Revue de Matériaux de Construction* (Paris), in the issue of August, 1933, P. Koper describes the results of studies made of clinker rings, termed (1) the ring of unburned material, which forms at a point where the raw material enters the clinkering zone, and (2) the coal ring, at the exit of this same zone near the point of combustion of the coal. The influence of these rings on the burning operation is discussed, and chemical analyses are tabulated of different rings, which greatly resemble those of the clinkers being produced, and of a fine grey powder found between the layers of the rings.

A detailed description of the process of ring formation is given. This depends, in the first place, on the chemical composition of the raw mix, and the silica modulus $SiO_2/Al_2O_3 + Fe_2O_3$ appears to be a predominant factor, raw mixes with a low silica modulus being prone to ring formation. The higher the silica modulus the more the ring approaches the clinkering zone, and with moduli between 2.5 and 2.6 the ring has a tendency to place itself at the point where the flame is hottest. Sulphur, acting as a flux, is also a factor in ring formation.

It is suggested that in order to avoid ring formation a silica modulus of between 2.5 and 3.0 should be maintained, and if, during the course of a run with a low modulus, ring formation becomes evident, the feeding of a siliceous powder for a few hours will suffice to remove it. Rings formed by sulphurous materials may also be removed in like manner. In some plants chains or steel balls suspended from chains are fixed in the interior of the kiln to prevent ring formation, and other devices such as vibration caused by hammers striking the outside of the kiln, and a gun described by Schirm (see *B. S. A.*, 1932, No. 257) are also mentioned.—From *Building Science Abstracts*, December, 1933.

EDITORIAL

Fuel Consumption Still High

AN editorial headed "Too Much Fuel," in the April (1933) Cement Mill Edition of "Concrete," brought out the fact that in February, 1933, the cement industry consumed the equivalent of 147 pounds of coal for each of the 2,777,000 barrels of cement produced in that month. This, of course, includes the coal consumed in the power plant and elsewhere, as well as in the burning process.

In February, 1934, the industry produced 4,168,000 barrels of finished cement, during which the fuel consumption amounted to 183,789 short tons of coal, 4,612,944 gallons of oil, and 1,799,245,000 cubic feet of natural gas.

Assume again that the heat value of the coal averaged 12,500 B.t.u. per pound, the oil 140,000 B.t.u. per gallon, and the natural gas 1,100 B.t.u. per cubic foot. If the sum of all these heat values is then expressed in terms of coal testing 12,500 B.t.u. per pound, the cement industry in February, 1934, consumed the equivalent of 138.5 pounds of coal per barrel of finished cement produced.

This indicates some improvement over the figure for February, 1933 (147 pounds of coal per barrel of finished cement), though some of the reduction may be due to the larger volume of production in February, 1934.

In any event, there is ample room for further reduction of fuel consumption in the manufacture of cement.

Improvements and Economies in Grinding

ANOTHER editorial on this page calls further attention to the excessive fuel consumption by the cement manufacturing industry.

While fuel consumption is one of the greatest single sources of waste in the industry—and the point where some of the largest items of saving may be realized—this is by no means the only major factor in the reduction of manufacturing costs. Even the saving of fuel may be attained in various ways, depending on the conditions and the equipment available in each individual plant.

There are few plants, for instance, in which substantial economies in grinding are not possible. In many mills this may be the greatest source of saving. No plant management should rest on its oars in this respect.

Fineness distribution is a property of cement that depends on the grinding equipment and methods employed at the cement mill—and fineness distribution is also a property in which the cement user is showing a keen interest.

As evidence of the growing curiosity about fineness distribution, consider the fact of the recent improvements in laboratory equipment for measuring the fineness of cement. Consider also the appearance in construction specifications of clauses requiring the measurement of fineness to be based on the specific surface, rather than the percentage retained on certain sieves.

With an increasing number of users demanding definite information on distribution of fineness and on specific surface, grinding operations must be conducted more scientifically and under more definite control in the future than has been the practice.

The point of greatest importance to the cement plant management is the fact that a thorough study of possible improvements in grinding methods and equipment will almost certainly lead to definite economies in grinding.

But even after all the economies in fuel and grinding costs have been explored, the possibilities for realizing reduction in manufacturing costs have not been exhausted. Every plant presents problems peculiar to itself. Only the most careful study in each case will uncover the points where costs may be cut without cutting quality.

Shipments Look Better

THE curve of cement shipments, shown in a chart on another page in this issue, has displayed an appearance of good health, or at least of convalescence, during the first four months of this year. Especially is this observable when the curve is compared with the corresponding period of last year.

Both this year and last year, cement shipments reached their minimum in February—a normal condition—but beginning with December the monthly volume of shipments has been well above the corresponding month of the year before.

The result is that total shipments for the first four months of 1934 stand at 17,846,000 barrels, compared with 13,239,000 barrels in the first four months of 1933, and 17,020,000 barrels in the same part of 1932. Thus has the present year maintained its lead over both 1933 and 1932.

Not since 1930 has the cement industry enjoyed the experience of an increased volume of shipments during the first four months of the year, as compared with the year before. This new experience brings with it the comforting feeling that so far as the cement industry is concerned the bottom was reached in 1933, and that the long-pull trend has started upward.

Much will depend on the enactment of further construction legislation in Washington during the closing days of the present sessions of Congress.

Air Separators and Multi-Chamber Mills Compared

By A. B. HELBIG

HALF a century ago the air separator was invented by the two English engineers, Moody and Mumford. The introduction of this machine in the grinding industry was very slow and many difficulties had to be overcome. Today the utility of the air separator is still disputed, but it has been acknowledged that the very fine powders, which are more and more in demand, can only be manufactured economically in plants with air separators, which must not be confused with air-swept mills, one-pass mills and combined or multi-chamber mills. The multi-chamber mill is most favored in spite of the fact that it uses much more power. The United States invention, the air-swept mill, has been introduced very rapidly in coal-grinding plants on the Continent; the mill takes about 60 per cent and the fan about 40 per cent of the total power consumption of the plant. If materials of higher specific gravity are ground in the air-swept mill the power consumption of the fan rises very rapidly, and a commercial success is very doubtful.

Feed Must Be Homogeneous

It has been stated that in the air separator the feed is segregated, but this assertion is without foundation. Hundreds of plants grind mixtures of materials of varying degrees of hardness without changing the composition of the feed. Any mill can only give a product of regular composition if the feed introduced into it is homogeneous. In many cases a homogeneous mixture run into the feed bin above the mill has come out very irregular on account of the shape of the bin or the difference in size of the materials.

In one plant a square bin with its bottom sloping to one side was filled with hard limestone broken to 1½ in. and very finely disintegrated clay weighed accurately together. Nevertheless the raw meal from the air separator varied from 55 per cent to 85 per cent in lime. The mill was blamed for this variation, but it was proved that the coarse limestone ran to the sides of the bin over the surface of the cone built up in the center of the bin by the fine limestone and the fine clay. The limestone was afterwards crushed in a hammer-mill to ⅛-in. size and the percentage in lime varied plus or minus 3 per cent.

Air Separators Requires Less Power

It has also been stated that the air separator cannot produce a finished product with a flour content as high as in the product of the multi-chamber mill, but this statement is also without foundation. With the air separator the percentage of flour in the product is not limited as it is in the case of the multi-chamber mill. It is true that the product of the air separator does not contain as much flour as the product of the multi-chamber mill with the same residue on the test screen; but it is also true that a cement with the same standard qualities can be ground with considerably less power in the air separator than in the multi-chamber mill. On the Continent the various components of the raw mixture for the dry process are mostly ground in air separators with perfect success.

Sieve Tests Inadequate

It is now generally agreed that the residue on a standard test screen can not be the basis of a scientific comparison of two grindings. The products with the same residue may show very different compositions in grain sizes; compare, in Table I, sample VII with sample I*e* and sample V*b* with sample I*d*. The only basis of comparison for scientific purposes is the percentage of grain sizes in μ, but the determination of these grain sizes should be internationally standardized and simplified.

TABLE I—MULTI-CHAMBER MILL CEMENTS

On sieves DIN 70 (4,900 meshes to the square centimeter) and DIN 100 (10,000 meshes to the square centimeter).

Mill	DIN 70 Per cent	DIN 100 Per cent	0-20μ Per cent	20-40μ Per cent	40-60μ Per cent	Over 60μ Per cent
I*a*	26.4	40.0	27.8	18.1	19.32	34.8
I*b*	20.4	36.0	30.07	19.5	21.49	29.94
I*c*	13.6	29.0	32.44	22.18	18.54	26.84
I*d*	9.2	20.0	36.11	27.54	23.01	13.34
I*e*	4.2	13.0	42.67	30.19	17.37	9.75
I*f*	1.7	6.6	53.2	28.44	13.98	4.38
II	9.0	22.5	39.9	20.4	18.55	21.18
III	8.6	21.8	34.96	23.47	23.25	18.34
IV*a*	18.2	28.4	37.9	21.4	20.4	20.3
IV*b*	11.0	21.4	41.95	23.9	20.84	13.31
V*a*	20.0	33.4	37.36	20.57	20.13	22.04
V*b*	9.5	23.4	41.94	23.69	22.18	12.19
VI*a*	33.4	46.0	28.58	18.04	18.04	35.12
VI*b*	7.0	20.0	43.45	25.53	22.31	9.71
VII	4.0	13.0	49.68	27.1	16.61	6.61

Note: Sieve DIN 70 corresponds to 178 meshes per lin. in., and DIN 100 is equivalent to 254 meshes per lin. in.

Differences in grain sizes with equal residue on the test screen are due to (1) the varying hardness of the mill feed; (2) the different lengths of the grinding path; (3) the grinding bodies used in the mills; and (4) the lining of the mills.

The object of this article is to prove that the percentage of fine and finest flour in the mill product is limited in the multi-chamber mill and unlimited in the air separator.

Comparing Multi-Chamber Mill and Air Separator

Table I gives results with multi-chamber mills of different size and construction grinding clinker of different hardnesses, and with different charges of grinding bodies. From this Table the conclusion is drawn that in grain sizes of 0-20μ, 55 per cent is the limit of multi-chamber products. This is sufficient for commercial cements, but it can not be claimed that it is very high.

The writer contends that with over 25 per cent grain sizes between 0 and 20μ the power consumption of the multi-chamber is higher than for the air separator. In table II are given results of air separated cements which prove that the percentage of finest flour is unlimited. Cement A is a commercial cement of high early strength. The four cements B were separated from the cement VII. The Gonell analysis distinctly shows the very fine gradations in grain sizes between 0 and 20μ produced by the sepa-

From *Cement and Cement Manufacture* (London), July, 1933.

rator. These cements were slow setting, of the same chemical composition and of highest standard qualities. The cement C is manufactured commercially.

TABLE II—WITH AIR SEPARATOR

Mill	DIN 70 Per cent	DIN 100 Per cent	0-20μ Per cent	20-40μ Per cent	40-60μ Per cent	Over 60μ Per cent
A	1.0	3.6	56.7	30.89	9.77	2.64
B*a*	0.0	0.0	93.52	5.38	0.72	0.38
B*b*	0.0	0.0	88.36	10.73	0.54	0.37
B*c*	0.0	0.0	81.63	16.4	0.81	1.16
B*d*	0.0	traces	68.66	30.27	0.77	0.3
C	0-10μ-55, 8%, 10-20μ 43.4%, over 20μ 0.8%.					

The writer was recently shown as "conclusive proof" that the air separator would not produce trass cement, the result of a comparative test grinding between a multi-chamber mill and the air separator shown in Table III. Irrespective of which mill and separator had been used, it should have been possible to regulate the separator so that the flour content of its product surpassed the product of the multi-chamber mill. The writer believes the mill was too short and that therefore the product contained insufficient fine flour, and that for this rather coarse product the separator did not run fast enough to load the circulating air stream sufficiently with grain sizes between 0 and 20μ. Therefore the air was saturated with slightly coarser grains, thus accounting for the 44.7 per cent of grains between 20 and 30μ and 24.2 per cent between 30 and 40μ. As the setting of the separator for the very fine product is so far a carefully guarded secret the operator is not to blame if the desired fineness is not obtained, especially as the present construction of the air separator does not allow economical production of the very finest meals. Even the expert has to experiment a long time.

TABLE III—COMPARATIVE GRINDING RESULTS

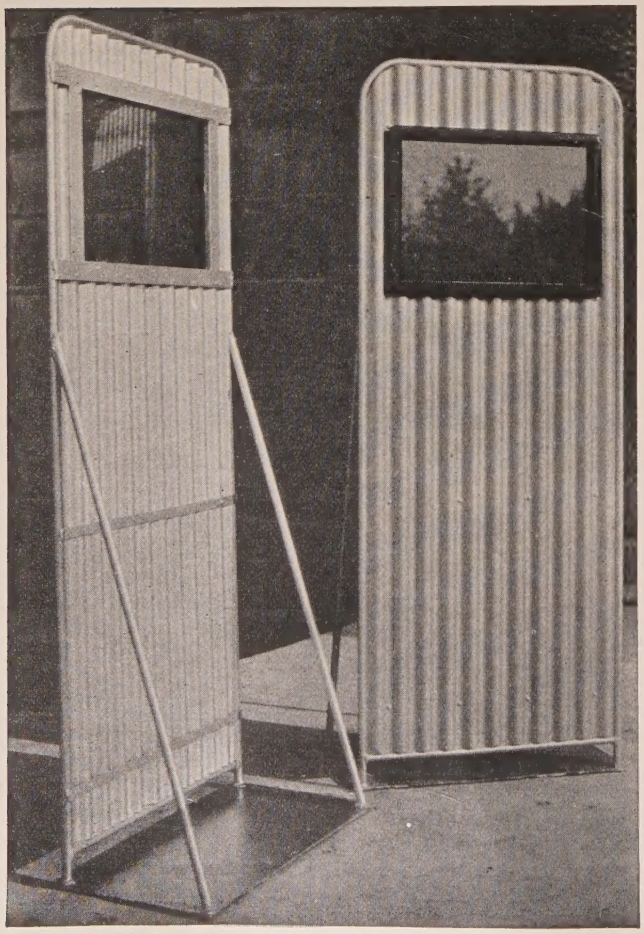
Mill	Under 5μ Per cent	5-10μ Per cent	10-20μ Per cent	20-30μ Per cent	30-40μ Per cent	40-60μ Per cent	Over 60. Per cent
M	18.5	13.1	27.8	14.5	9.8	10.1	6.4
S	4.4	1.7	9.0	44.7	24.2	9.0	7.0

For coarse-finished products efficiencies of 80 per cent and more can be guaranteed. The control of fine grinding installations with the formulæ for the control of air separators shows very low separator efficiencies in air separating plants for very fine products.

In the latest grinding plants the author found, at 6 per cent residue on the standard German test screen, 21 per cent efficiency for the one-pass separator, at 3.7 per cent residue 15.4 per cent, and at 1.2 per cent residue only 11.5 per cent efficiency.

The difficulty of regulating the separator and keeping it in working order is chiefly responsible for the reluctance to use it. The way for the general use of the air separator will be open when men without special knowledge are able to set the separator for the different desired finenesses in the shortest time and to obtain efficiencies of more than 70 per cent.

New Shield Protects Kiln Burner from Flare-Backs and Heat



Corrugated Asbestos Roofing with Plate Glass Panel at Level of Kiln Opening

AN eastern cement plant has developed a new and unique type of shield for protecting the kiln burners from the discomfort of heat radiation and the danger of injury from flare-backs and puffing. Essentially, the shield consists of a screen of corrugated asbestos roofing, with a plate glass panel set in a frame at the level of the observer's eyes.

Small-diameter pipe was utilized for making the framework of these shields. Similar pipe was used for the supporting-arms extending from the shield to a base of sheet steel on which it rests. This makes the whole arrangement steady, as it rests on the floor. Within the frame a large panel of corrugated asbestos roofing is inserted and held in place by strips of flat iron stock. At normal eye level, a large aperture is cut in the asbestos roofing and a frame of steel is made in which is inserted a section of ¼-in. plate glass through which observation can be made.

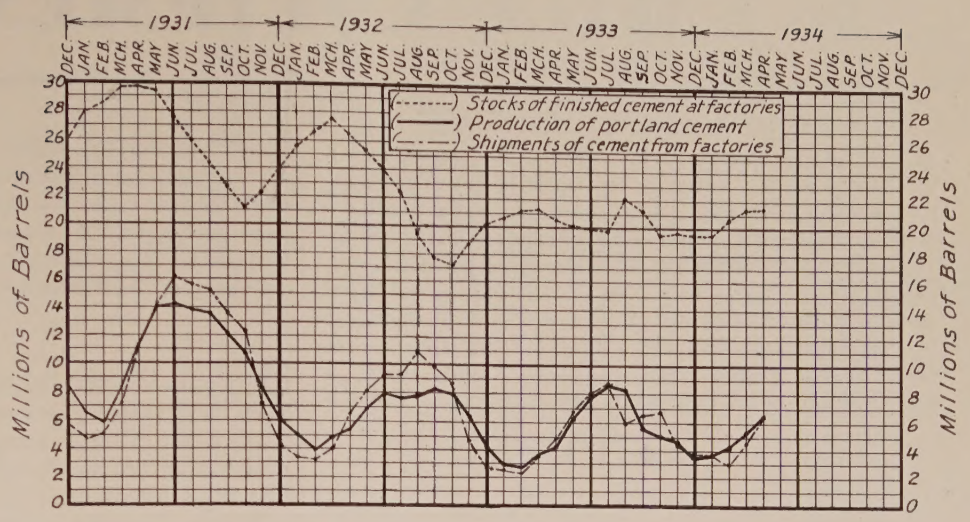
The whole assembly is of welded construction, except for the bolts which hold the asbestos roofing to the cross strap supports. The ends of the straps are, of course, welded to the pipe frame, as are the ends of the glass frame.

In use the shield is placed 5 or 6 ft. in front of the kiln hood and observation opening. The floorplate of the shield is forward, so that the operator can stand behind it without any possibility of stumbling or catching his foot on either the floorplate or the supporting pipe frame. In order to further stabilize the arrangement, a weight is placed on top of the floorplate.

The entire shield is coated with aluminum paint.

Cement Statistics for April

PRODUCTION of portland cement in April, 1934, showed an increase of 56.4 per cent and shipments an increase of 31.3 per cent, as compared with April, 1933. Portland cement stocks at mills were 4.5 per cent higher than a year ago.



Relation of Production to Capacity (Per Cent)

	The Month	Twelve Months
April, 1934	29.6	25.9
April, 1933	18.9	26.2
March, 1934	23.0	25.0
February, 1934	20.2	24.4
January, 1934	16.6	23.9

Production, Shipments and Stocks of Finished Portland Cement (Barrels)

	1933	1934
Production, April	4,183,000	6,544,000
Shipments, April	4,949,000	6,498,000
Stocks at end of month	20,542,000	21,468,000
Production for year to date	13,602,000	19,748,000
Shipments for year to date	13,239,000	17,846,000

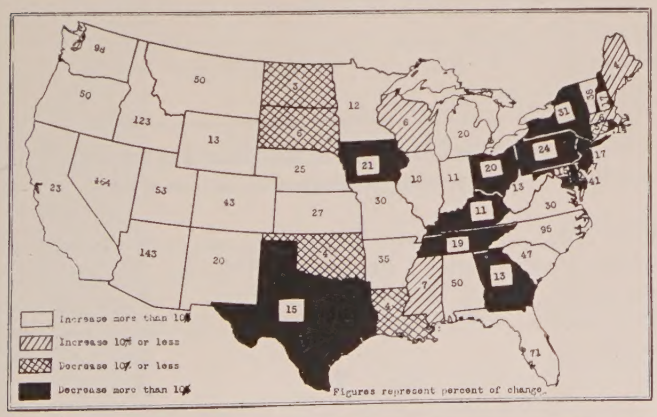
In this statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 163 plants at the close of April, 1934, and of 164 plants at the close of April, 1933.

Cement Map Growing Whiter

Upward Trend of Cement Shipments Shown in Comparison with Older Maps

THE cement map of the United States continues to grow whiter—which means that shipments are improving throughout the country as a whole, by comparison with a year ago.

In the map here shown the black areas represent states in which cement shipments for the 6-month period ending March 31, 1934, were more than 10 per cent under the shipments in the 6-month period ending March 31, 1933. The double-hatched areas are states in which the decrease was 10 per cent or less.



The single-hatched and the white areas are states in which shipments in the 6-month period ending March 31, 1934, were greater than in the corresponding period of the year before—the single-hatched areas representing an increase of 10 per cent or less, and the white areas an increase of more than 10 per cent. The more recent upward trend is shown in the following tabulation:

Period Considered	Number of States Showing decrease	Showing increase
6-month period ending Jan. 31, 1934	34	14
6-month period ending Feb. 28, 1934	27	21
6-month period ending March 31, 1934	17	31

Thus in the comparison with the corresponding period ending a year earlier, a decided improvement occurred in the course of two months.

Chemical Society Meets

MORE than seven hundred persons attended the twelfth Midwest Regional Meeting of the American Chemical Society at Kansas City on May 3 to 5. Among the many interesting papers were a number on inorganic and physical chemistry, petroleum, and paint. A high light of the meeting was an address by Dr. Robert A. Millikan, director of Normal Bridge Laboratory, California Institute of Technology, on "Some Recent Advances in Nuclear Physics."

Foreign Cement Barred by P WA

FOREIGN competition with American firms supplying materials for public works projects was effectively shut off on April 1 in a public works administration order increasing the differential on foreign bids to 20 per cent.

Mill Equipment

THE Hardinge Company, Inc., York, Pa., announces a brand new classifier, described in Bulletin 39. They say: It rotates around its own setting pool, it lifts and rolls—does not scrape—the oversize up an incline, it overflows the fines free of oversize by reducing agitation where agitation should be reduced, it won't stall when overloaded or balk when started full of material, it cannot be damaged by foreign material entering with the feed, and, it has passed the test period—four commercial sizes under a dozen different conditions have been employed for the purpose.

●

STOPEHAMER is a new drill announced by Ingersoll-Rand Company, Phillipsburg, N. J., in Flier No. 2051, which shows several illustrations, both exterior and interior views of the machine and also pictures of the new drill in operation in mines.

Industrial Literature

LINK BELT COMPANY, Chicago, has recently completed a new General Catalog of 1,024 pages, with list prices effective April 1.

The book is referred to as a Handbook of Practical Information on Link-Belt Cost-Reducing Machinery—for the mechanical conveying and preparation of materials, and the transmission of power. It gives engineering and dimensional data, and should prove useful to the designing engineer and buyer alike.

Among the equipment covered are elevating and conveying chains, elevator buckets, sprocket wheels, chain drives, power transmission machinery, positive variable speed transmission units, standardized bucket elevators, apron conveyors, screw conveyor, belt conveyors, bucket elevators and conveyors, flight conveyors, car dumpers, sand and gravel plant equipment, coal and ashes handling machinery, etc.

●

BRACKET Bearing Synchronous Motors is a new publication by Allis-Chalmers Mfg. Co., Milwaukee, illustrating and describing its line of motors. In addition to the standard line for general requirements, including exciters, control equipment, etc., the bulletin also treats motors with special features of construction, such as anti-friction bearings, enclosed collector rings, splashproof type, enclosed fan-cooled type, and vertical motors.

The Bulletin also contains a discussion of use of the synchronous motor for improvement of power factor with examples applying the graphical method for figuring power factor corrections.

●

INSULATION in the Lime and Cement Industries, is a new book describing insulation methods said by Johns-Manville, New York, to have proved effective in reducing operating costs on rotary cement and lime kilns, vertical lime kilns, settling chambers, waste heat flues, boilers, piping and auxiliary power plant equipment. Recommendations therein cover not only the proper material and the most economical thickness to use for each condition, but also detailed specifications and drawings on method of installation. Performance data are also included.

●

DREADNAUGHT Buckets is the title of Blaw-Knox Form No. 1339. Features mentioned are: one-piece cast head, heavy, forged one-piece corner bars, high carbon steel cutting lips and hardened steel pins and guide rollers. The latest improvement is ball-bearing equipped sheaves, a feature claimed to eliminate lost time and expense, resulting from sheave bearing trouble.

●

MANGANESE Steel Sheaves is the subject of a 4-page leaflet being distributed by the American Manganese Steel Co., Chicago Heights, Illinois.

Manganese steel, they claim, is ideal for sheaves, because of its long wearing qualities and, on account of its non-friable structure, is claimed to prolong the life of both the rope and the sheaves.

●

MACHINERY for Complete Crushing Plants is a new bulletin published by Allis-Chalmers Mfg. Co., Milwaukee, Wis., illustrating and describing their types and sizes of crushers, rolls, pulverators, sizers, grizzlies, vibrating and revolving screens, scrubbers, washers, dewaterers, feeders, conveyors, hoists, elevators, portable plants, drives, motors, pumps, compressors and tractors.

●

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has issued a new illustrated leaflet describing type CR single phase repulsion-start induction motors. These motors are available for 110-220 volt, 25-50-60 cycle service in sizes from ¾ to 3 horsepower. They are especially designed for heavy industrial service.

Among the Manufacturers

THE Babcock & Wilcox Tube Company announces that the territory served by its Tulsa, Oklahoma Sales Office, managed by C. J. Hochenauer, has been enlarged to include the State of Oklahoma and the Southern half of Kansas.

●

Tom B. Douglas has resigned as advertising manager of the Dewey Portland Cement Co., Kansas City, Missouri, to join the Murrel Crump Advertising Co. as manager of its Kansas City Office.

●

Wilbur G. Hudson has been appointed chief engineer of Link-Belt Company's Pershing Road Plant in Chicago.